White Tanks FRS No. 3 Outfall Channel
Final Design

FCD 2009C012 - FINAL DRAINAGE REPORT

Prepared for:
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February 2011

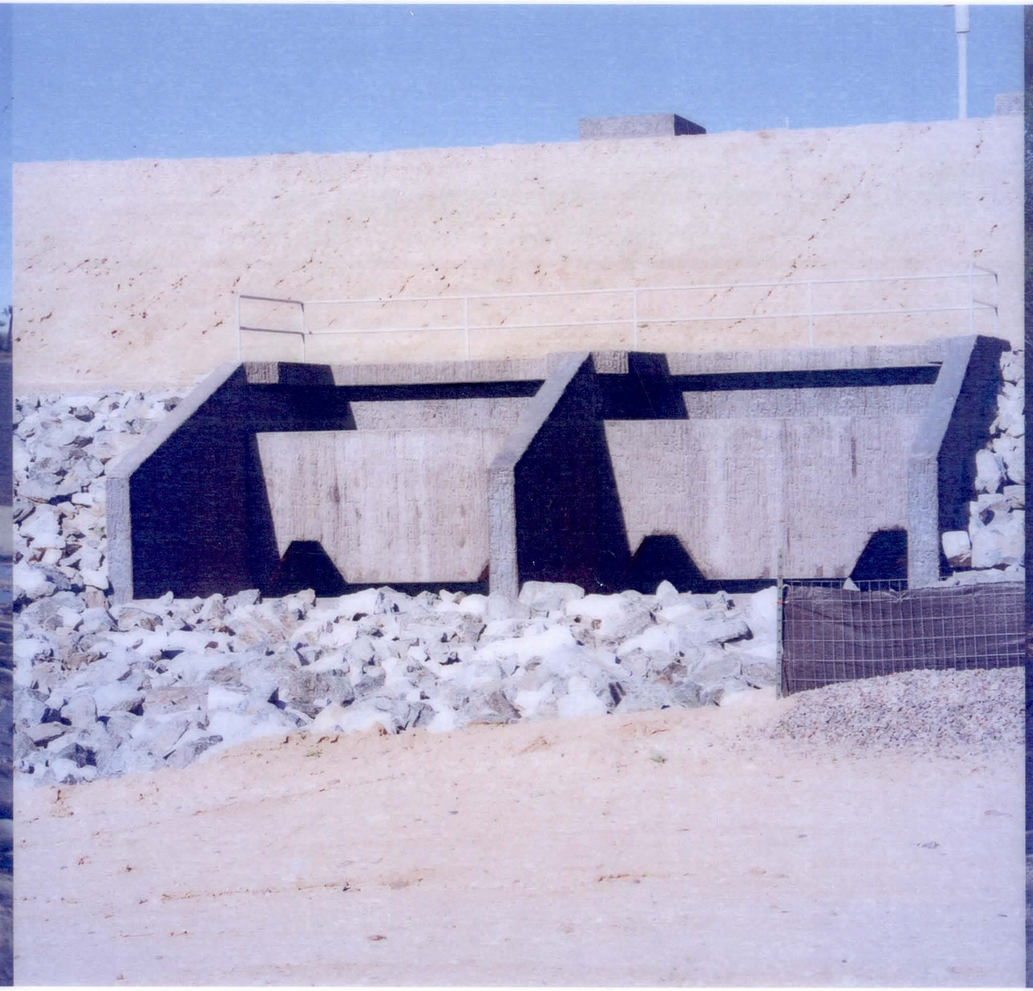

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TABLE OF CONTENTS

1 Introduction 1
1.1 Stakeholders 3
1.2 Purpose 3
1.3 Authority for Study 3
1.4 Location of Study 3
2 Hydrology 4
2.1 NOAA 14 Rainfall 4
2.2 Future Land Use and Retention 4
2.3 White Tanks FRS#3 Storage Routing 6
2.4 Rainfall Loss, Unit Hydrograph, and Routing 6
2.5 Existing Conditions with Project in Place 6
2.6 Future Conditions with Project in Place 6
2.7 Design Discharges 6
2.8 Probable Maximum Flood (PMF) for FRS#3 7
2.9 Rational Method – Local Drainage 7
3 Hydraulics 9
3.1 Soil Data and Permissible Velocity 9
3.2 Channel Hydraulics – HEC-RAS Modeling 9
3.3 Reach 9 Design 10
3.4 Channel Hydraulics – Trashrack Headloss 11
3.5 Sedimentation Analysis 11
3.6 Scour Analysis 11
3.7 Stepped Spillway Design 12
3.8 Structure Seepage Analysis and Cut-Off Wall Design 12
3.9 Diversion at Litchfield Heights 13
3.10 Wasteway Flows to Beardsley Canal and Wash 13
3.11 Riprap Sizing 13
4 Conclusions 15
5 References 16

Figures

Figure 1 Location and Vicinity Map 1
Figure 2 Project Schematic Map 2
Figure 3 Watershed Map with Future Condition HEC-1 Scheme 5
Figure 4 Wasteway Flow Inundation Area 14
Figure A.1 Schematic Map for Jackrabbit Corridor HEC-1 Model, Future Condition with Project in Place A-1
Figure A.2 Schematic Map for Jackrabbit Corridor HEC-1 Model, Existing Condition with Project in Place A-2
Figure A.3 Schematic Map for FRS#3 HEC-1 Models, Future Conditions A-3
Figure A.4 Schematic Map for FRS#3 HEC-1 Models, Existing Conditions A-4
Figure C.1 Tributary Basin and Wash Map 1 ..... C-1
Figure C.2 Tributary Basin and Wash Map 2 ..... C-2
Figure H.1 Wasteway Inundation HEC-RAS Work Map 1 ..... H-8
Figure H.2 Wasteway Inundation HEC-RAS Work Map 2 ..... H-9

Tables

Table 1 HEC-1 Sub-Basin Land Use and Retention for Future Conditions 4
Table 2 HEC-1 Model and Design Discharges 7

Electronic Data

HEC-1 Models
HEC-RAS Models
SITES Model and Tech Memo by URS

EXPIRES 3/31/2012

Appendices

Appendix A Hydrologic Modeling A-1
A.1 Schematic Maps A-1
A.2 Future Conditions with Project in Place, 10-Year for Jackrabbit Corridor A-5
A.3 Future Conditions with Project in Place, 100-Year for Jackrabbit Corridor A-8
A.4 Existing Conditions with Project in Place, 10-Year for Jackrabbit Corridor A-11
A.5 Existing Conditions with Project in Place, 100-Year for Jackrabbit Corridor A-19
A.6 Future Conditions 10-Year for FRS#3 Major Basin A-27
A.7 Future Conditions 100-Year for FRS#3 Major Basin A-33
A.8 Existing Conditions 10-Year for FRS#3 Major Basin A-39
A.9 Existing Conditions 100-Year for FRS#3 Major Basin A-45
A.10 Hydrological Information from the FRS3 Phase I Design Report A-51
Appendix B Channel Hydraulics B-1
B.1 HEC-RAS Model - Mixed Flow Analysis with n=0.020 ..... B-1
B.2 HEC-RAS Model - Subcritical Flow Analysis with n=0.035 ..... B-17
B.3 HEC-RAS Model - Subcritical Flow Analysis with n=0.045 ..... B-26
B.4 Trashrack Headloss B-36
B.5 Broken-Back Culvert Performance B-37
B.6 Tailwater Condition of Principal Spillway B-38
B.7 Downdrain Capacity B-39
Appendix C Sediment Analysis C-1
C.1 Map of Tributary Basins and Washes C-1
C.2 Peak Discharges and Runoff Volumes of Tributary Flows C-3
C.3 Sediment Yields C-5
C.4 Sediment Basins C-6
Appendix D Emergency Spillway Scour Analysis D-1
Appendix E Stepped Spillway Design E-1
Appendix F Riprap Sizing, Cut-Off Wall and Seepage Analysis F-1
Appendix G Diversion at Litchfield Heights G-1
Appendix H Wasteway Flow Inundation H-1
H.1 Manning's Roughness Coefficient H-1
H.2 HEC-RAS Model H-2
H.3 HEC-RAS Work Map H-8
H.4 Wasteway Normal Depth Calculations H-10

EXPIRES 3/31/2012

1 INTRODUCTION

Hoskin Ryan Consultants, Inc. (HRC), has been contracted by the Flood Control District of Maricopa County (District) to prepare final design for the White Tanks FRS No. 3 (FRS#3) Outfall Channel project. The District is in the process of performing rehabilitation to FRS#3, including a new Principal Spillway that discharges adjacent to the Beardsley Canal. The project provides a channel along the Jackrabbit Trail corridor, to convey the Principal Spillway flows from FRS#3 to FRS#4. The outfall channel will extend south from the Principal Spillway of FRS#3 to the existing FRS#4 inlet channel north of McDowell Road, and will lie within the Town of Buckeye and unincorporated Maricopa County.

The goals of the project include:

- Provide an outfall for the FRS#3 Principal Spillway flows.
- Intercept and convey the 100-year flood flows reaching the channel to the planned outfall at FRS#4.
- Reduce the effective FEMA 100-year floodplain along Jackrabbit Trail.
- Accommodate the future widening of Jackrabbit Trail.
- Design the facilities to complement the existing and planned future setting through implementation of context sensitive planning and design.
- Provide an opportunity to implement trail linkage as part of the Maricopa County Regional Trail System.

The existing FRS#4 inlet channel is a concrete-lined channel which extends from south of Interstate 10 (I-10) to north of McDowell Road. North of the existing concrete-lined channel, the existing Jackrabbit Channel and Wash are a series of unlined channels and ditches of varying dimensions and capacities. Between Missouri Avenue and the Bethany Home Road alignment, natural drainage patterns continue across the Jackrabbit Trail alignment from west to east. From the Bethany Home Road alignment north to FRS#3, the predominant land slope is east towards the Beardsley Canal.

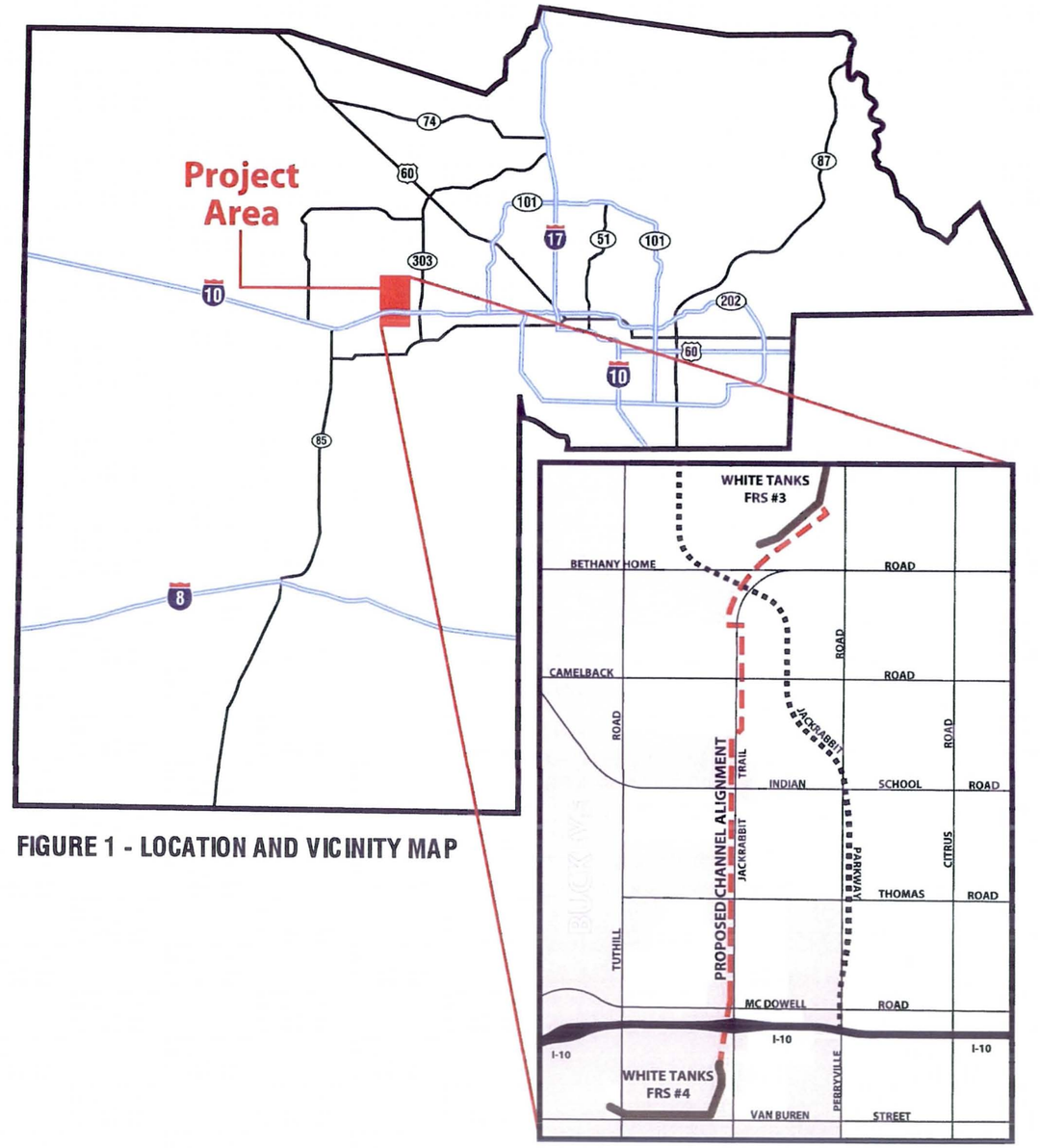

FIGURE 1 - LOCATION AND VICINITY MAP

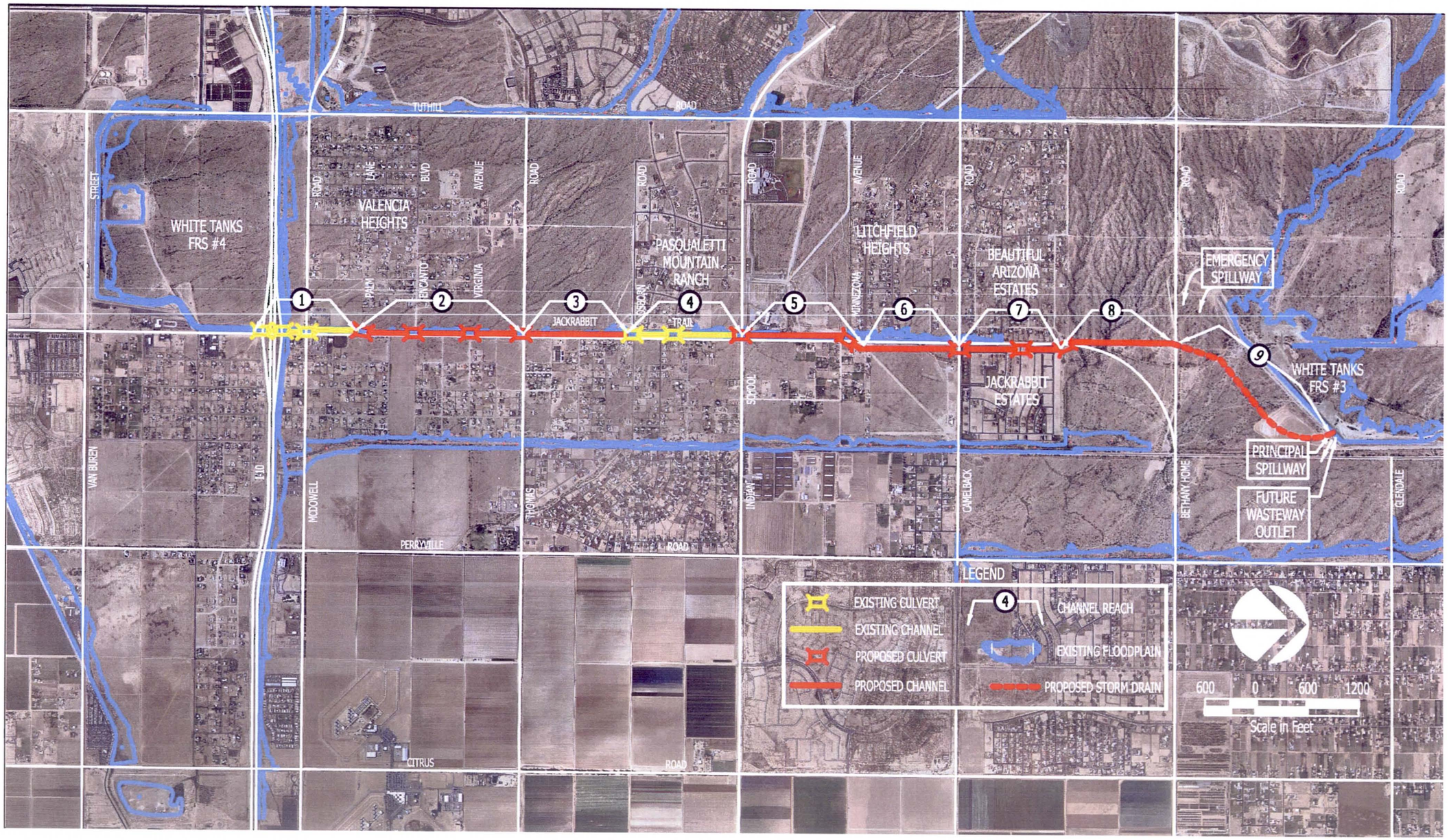

FIGURE 2 – PROJECT SCHEMATIC MAP

1.1 Stakeholders

On-going projects and interested stakeholders include the District, the Arizona Department of Water Resources (ADWR), the National Resources Conservation Services (NRCS), Maricopa County Department of Transportation (MCDOT), the Town of Buckeye, the Maricopa County Municipal Water Conservation District (MWD), existing developments such as Arroyo Mountain Estates (Jackrabbit Estates), Beautiful Arizona Estates, Pasqualetti Ranch, and Litchfield Heights, and private development interests such as DMB White Tanks (Verrado, north of Indian School Road) and SouthWest Value Partners (north of Missouri Avenue).

1.2 Purpose

This report is submitted in conjunction with the *White Tanks FRS No. 3 Outfall Channel Design Report, Final Submittal* (Ref. 23) and Final Plans (Ref. 18). The Design Report presents engineering design and analysis and landscape design. The Drainage Report documents the hydrologic and hydraulic analysis for the design.

1.3 Authority for Study

A detailed Scope of Work was formulated as a part of the contract and proposal process. The Flood Control District of Maricopa County's contract number is FCD 2009C012. The official Notice to Proceed date is October 22, 2009. The District Project Manager is Gary Wesch, P.E.

1.4 Location of Study

The main area of interest lies along Jackrabbit Trail between FRS#3 and FRS#4, from approximately Roosevelt Street to Glendale Avenue, and includes the jurisdictions of the Town of Buckeye and unincorporated Maricopa County. The immediate watershed area contributing to the channel extends west to Tuthill Road, and north to FRS#3. Additionally, the watershed includes all areas, which drain into the FRS#3 from the White Tanks Mountains, east to the Perryville Road alignment and north to McMicken Dam, near the Cactus Road alignment.

2 HYDROLOGY

HEC-1 models were prepared for the "existing conditions with project-in-place" and "future conditions with project-in-place." The existing conditions model was created in December 2009 and was based upon the *Loop303/White Tanks ADMPU Area Hydrologic Analysis* (the ADMPU AHA) submitted by HDR on September 4, 2009 (Ref. 17). The future conditions model was prepared in June 2009 for the *White Tanks FRS No.3 Outfall Channel 30% Design Report* (Refs. 19, 20), and was based upon the ADMPU AHA submitted by HDR on March 9, 2009. Both models have been updated to reflect the adoption of closed conduit at Reach 9.

2.1 NOAA 14 Rainfall

As shown on the watershed map (Figure 3), the drainage area includes two distinct terrains: the mountainous terrain contributing runoff to FRS#3, and the relatively flat range terrain contributing to the Jackrabbit Channel. The mountainous area which contributes to FRS#3 receives a higher precipitation depth than the Jackrabbit Corridor downstream of Bethany Home Road. Since JD records were used in the ADMPU HEC-1 models to account for area-depth reduction, an individual precipitation depth for each sub-basin (PB record) could not be used.

To reflect the precipitation difference between the mountain terrain and range terrain precipitation values, the watershed was divided into two major basins. The FRS#3 major basin covers the watershed area upstream of White Tanks FRS#3. The Jackrabbit Corridor covers the watershed area downstream of FRS#3. Separate HEC-1 models were created for each major basin. HEC-DSS was employed for data transfer between the two models.

The NOAA 14 precipitation depths were obtained using DDMSW (Ref. 25). The 100-year 24-hour NOAA 14 rainfall depths for the FRS#3 major basin vary from 4.80 inches to 3.65 inches. An area-weighted average depth of 4.016 inches was applied to the model for this area. Within the Jackrabbit Corridor, the variation in NOAA 14 rainfall depth is less than 0.10 inch. A 100-year, 24-hour area-weighted average depth of 3.661 inches was applied to the Jackrabbit Corridor model.

For 10-year events, the point precipitation depths are 2.572 inches and 2.353 inches for the FRS major basin and Jackrabbit Corridor, respectively.

2.2 Future Land Use and Retention

Changes made to sub-basin land uses and retentions for future conditions are summarized in Table 1. As shown in the HEC-1 schematic maps (Figures A.1, in Appendix A), the models include Sub-Basins W28A, and W33 through W38. The retention volume for Verrado (W34 and W35) was obtained from the Verrado Master Drainage Plan (Ref. 39). The retention volumes for the remaining sub-basins represent 80% of the required site retention volume for the 100-year 2-hour precipitation of 2.3 inches (NOAA 14).

Table 1: HEC-1 Sub-Basin Land Use and Retention for Future Conditions

Sub-Basin	Communities	Land Use	Retention (AF)	Note
W28A	Beautiful Arizona Estates, Maracay Development	Large and Medium Lot Residence	30.0	Maracay future development will provide retention.
W33	Beautiful Arizona Estates, Litchfield Heights	Large Lot Residential	0	Neither community provides retention.
W34 and W35	Verrado	School and Residential	23.0	According to Verrado Drainage Report
W36	Pasqualetti Mountain Ranch, Arroyo Seco	Large Lot Residential	12.7	Pasqualetti does not provide retention. Arroyo Seco will provide retention for future development
W37A	Arroyo Seco, Valencia Heights	Large Lot Residential	16.1	Valencia Heights does not provide retention. Arroyo Seco will provide retention for future development.
W37B	Arroyo Seco, Valencia Heights	Large Lot Residential	3.0	Valencia Heights does not provide retention. Arroyo Seco will provide retention for future development
W38		Regional Commercial	10.4	Future development will provide retention.

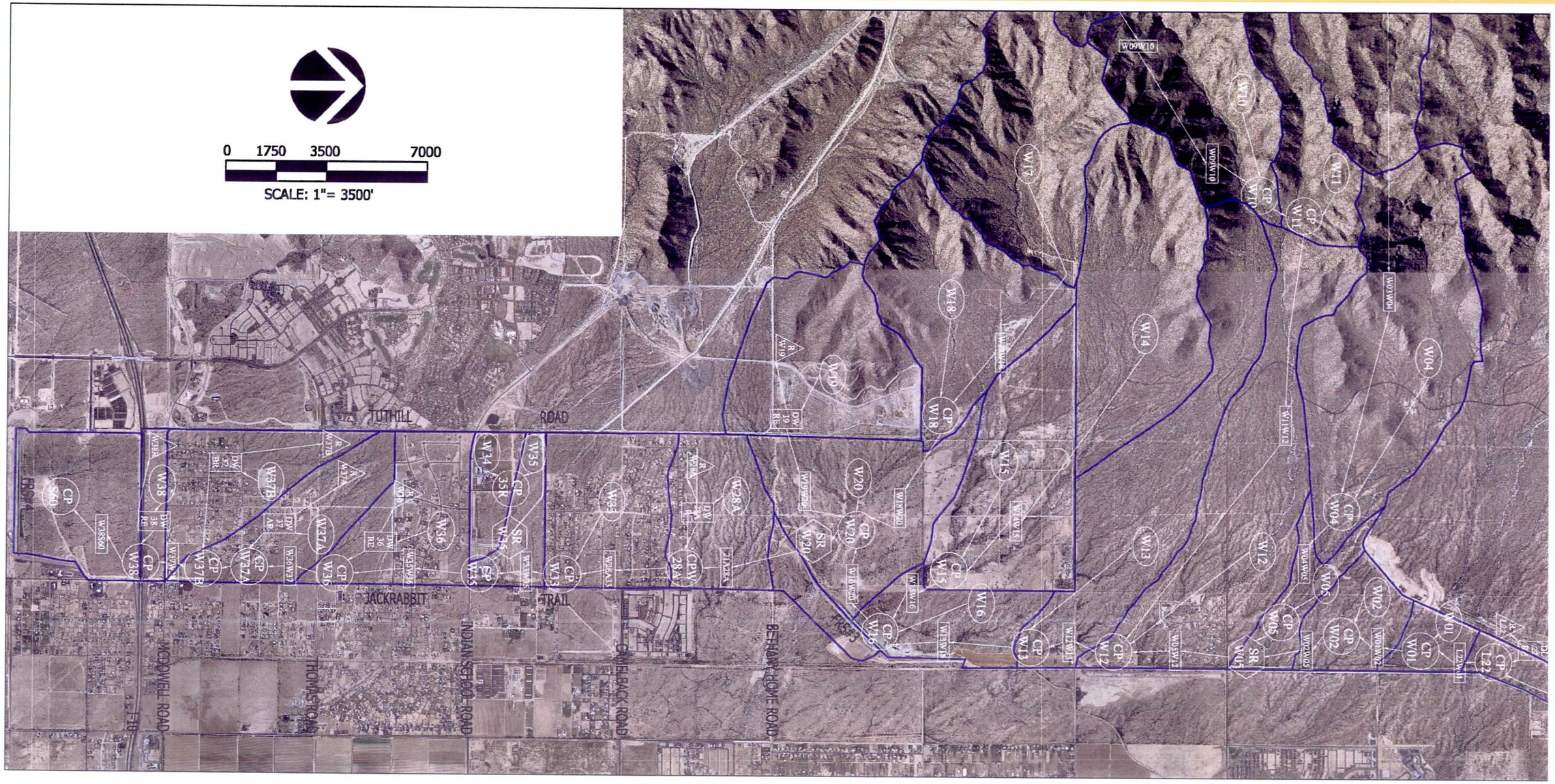

FIGURE 3 – WATERSHED MAP WITH FUTURE CONDITION HEC-1 SCHEME

The retention volume provided for the Verrado school grounds provides sufficient storage for the 100-year, 24-hour runoff from its contributing area. Accordingly, the tributary area was adjusted by approximately 0.184 square miles. In the future, when development occurs, the remaining portion of the Verrado development runoff will be collected and detained by a separate basin to be located at the northwest corner of Jackrabbit Trail and Indian School Road. The volume in this basin will be approximately 23.0 acre-feet, which was included in the HEC-1 models.

2.3 White Tanks FRS#3 Storage Routing

The capacity of the principal and emergency spillways, storage volume, capacity of the gated outlet, and infiltration rates at different elevations were obtained from the *White Tanks FRS No.3 Remediation Project - Phase I, Design Report Volume 2* (Ref. 34).

The stage-storage-discharge curve for the condition with the principal spillway open and the gated outlet closed was used for FRS#3 storage routing. The discharge in the stage-storage-discharge curve accounts for the outflow from the principal outlet plus the natural infiltration within the reservoir. A diversion was added, following the storage routing, to separate the natural infiltration from the outflow. The outflow from FRS#3 was stored in a HEC-DSS file for retrieval by the Jackrabbit Corridor HEC-1 model. The peak flow of the 100-year 24-hour storm from the principal outlet was computed to be 195 cfs.

2.4 Rainfall Loss, Unit Hydrograph, and Routing

The Green-Ampt method was used for rainfall loss calculations, and the Valley S-Graph for the creation of unit hydrographs. Normal depth routing was used to route flows through the proposed channel. Variables for Green-Ampt losses, unit hydrographs, channel and reservoir routing were based on those presented in the *Loop303/White Tanks ADMPU Area Hydrologic Analysis* (Ref. 17) and *Verrado Planning Unit Drainage Plan for Portions of Planning Units II & IV and Update to Master Drainage Plan* (Ref. 39). The unit hydrographs for Sub-Basins W37A and W37B were obtained using MCUHP2 and Valley S-Graph.

2.5 Existing Conditions with Project in Place

Existing conditions models for the 10-year and 100-year storm events were created based upon the "existing conditions with CIP" model (ECIP-MB2.dat) of the ADMPU AHA. Modifications for this project include updates to NOAA 14 precipitation, the stage-storage-discharge curve of FRS#3, retention volumes, and routing channel geometries. The computed existing conditions discharges along channel are shown in Table 2.

The ADMPU AHA model applied a retention volume of 12.5 acre-feet for the Pasqualetti Mountain Ranch. While the Final Plat indicates on-lot retention; neither the current nor the future development appear to provide on-lot retention. To be conservative, the retention diversion was removed from the model.

The proposed channel were used to update the channel routing in the ADMPU AHA model.

2.6 Future Conditions with Project in Place

A future conditions model for the 10-year and 100-year storm events were created based upon the "future condition with CIP" model (Future_CIP_MB02.dat) of the ADMPU AHA. Modifications made for this project include updates to land use types, retention volumes, NOAA 14 precipitation, and routing channel geometries. The computed future conditions discharges along the channel are shown in Table 2.

Table 2 indicates that the peak discharges between Indian School Road and McDowell Road, i.e. Reach 2 to Reach 4, will decrease in the future, resulted from the additional retention provided by the future development of Verrado and Arroyo Seco. The design discharges were based on future conditions.

The HEC-1 output for the Jackrabbit Corridor future and existing conditions with project-in-place are provided in Appendix A.

2.7 Design Discharges

The design discharges are generally rounded up based on the output from the future conditions (Table 2). A decrease of the design discharges from Reach 5 to Reach 4 is resulted from the attenuation of the routing through Reach 5 (W33W35) in the future conditions hydrological model. The attenuation is caused by the wide

channel of half mile with a mild slope. In addition, due to the proposed retention at the Verrado future development, the local flow from Verrado routed through the retention is not additive to the peak at Indian School Road. Therefore, the design discharges are reduced from 800 cfs at Reach 5 to 700cfs at Reach 4.

The flow within Reach 8 varies from 285 cfs at the upstream end to 700 cfs at the downstream end. Two washes, with a tributary area of 150 acres for each, join the channel at Reach 8. Both washes have enough conveyance to contain the 100-year peak within the washes. To reflect the variation through Reach 8, the flow rate is prorated along Reach 8, with 300 cfs upstream of the first wash, 500 cfs between two washes, and 700 cfs downstream of the second wash.

The design discharges are based on the future conditions and are less than the existing 100-year condition at Reaches 2, 3 and 4. Less peak flows are expected for the future conditions at these reaches because of the future retention provided by Verrado and Arroyo Seco development.

Table 2: HEC-1 Model and Design Discharges

Reach	Existing Conditions			Future Conditions			Design Discharge
	Concentration Point	100-Year	10-Year	Concentration Point	100-Year	10-Year	
Reach 1	CPW37	1073	353	CPW38	1549	397	1549
Reach 2	CPW36	931	286	CPW37A	648	222	700
Reach 3	CPW36	931	286	CPW36	664	241	700
Reach 4	CPW35	851	294	CPW35	701	302	700
Reach 5	CPW33	790	293	CPW33	795	360	800
Reach 6	CPW33	790	293	CPW33	795	360	800
Reach 7	CPW28A	507	211	CPW28A	575	81	700
Reach 8c *	CPW28A	507	211	CPW28A	575	81	700
Reach 8b *							500
Reach 8a *							300
Reach 9	WT3	187	13	WT3	195	81	285

** The flow within Reach 8 varies from 285 cfs at the upstream end to 700 cfs at the downstream end. Two washes with a tributary area of 150 acre each join the channel at Reach 8. Therefore, the flow rate is prorated along Reach 8, with 300 cfs upstream of the first wash, 500 cfs between two washes, and 700 cfs downstream of the second wash.*

2.8 Probable Maximum Flood (PMF) for FRS#3

The Natural Resource Conservation Services (NRCS) developed Probable Maximum Flood (PMF) hydrographs for various Probable Maximum Precipitations (PMP) using TR-20. The TR-20 model prepared by NRCS was updated by URS for the *FRS3 Remediation Project* (Refs.33, 34). The updated models were based on the future operation condition with the sediment pool being filled to the principal spillway crest, the gated outlet closed and the principal spillway being open. The FRS#3 reservoir routing results for future conditions indicate that the 6-hour local PMP will cause the highest maximum reservoir elevation, i.e. 1216.0 feet (NAVD 88), among various PMP events (Appendix A), with a corresponding Principal Spillway discharge of 284 cfs. As a result, the design discharge for Reach 9 was set at 285 cfs. Peak flows of other PMP events can be found in Appendix A.

Generally, the minimum reqirement for the pipe capacity downstream of dam to meet NRCS criteria is the peak flow during the 100-year 10-day PSH. However, as indicated in the FRS3 Phase I Design Report (Refs. 33, 34), the 100-year 10-day storm results in a peak flow of 216 cfs, which is less than the peak flow of 285 cfs from the 6-hour local PMP. Therefore, the flow of 285 cfs was selected as the design discharge for pipes instead of the peak flow of the 100-year 10-day PSH.

2.9 Rational Method – Local Drainage

The Rational Method was used to quantify the discharges from local natural washes that will be intercepted by the proposed channel (Figure C.1 and C.2 of Appendix C). Computations were based upon the NOAA 14 precipitation depths using DDMSW (Ref. 25). The "Open Space" land use type was selected for all existing vacant lands except those within the future Verrado development.

In all cases but two, the contributing drainage areas are less than 160 acres. For the calculations of concentration times, the longest flow paths were identified from the 2-foot interval mapping produced for Loop 303/White Tanks ADMPU Area Hydrologic Analysis (Ref. 17) and the slopes were identified along the longest flow

paths. The Rational Method calculations are included in Appendix C.

Side inlet spillways composed of stepped concrete will be used for all side inlets with 100-year peak flows of 60cfs or greater. In some cases, riprap will be placed within drainage easement west of the District's right-of-way. The side inlet spillways are sized to contain the 100-year peak flows and riprap stilling basins are designed to dissipate the flow energy. The design of the side inlet spillways is discussed in Section 3.5. For washes and and drainageways of less than 60 cfs, grouted riprap downdrains will be provided. The normal depth calculations for the grouted riprap downdrain are presented in Appendix B.7.

3 HYDRAULICS

3.1 Soil Data and Permissible Velocity

Alpha Geotechnical and Materials, Inc., geotechnical subconsultant for this project, collected and tested 60 soil samples along the proposed channel alignment, 5 soil samples at the stockpile, and 12 soil samples within the sandy bottom of the Jackrabbit Wash (Ref.1). Test results show that the penetration resistance ranges from 8-80 blows per foot, which indicates firm or hard soil covers the project area. The grain size distribution from the laboratory tests indicates that the soil at the design depth of the channel is sandy loam and generally contains about 30% silt.

The channel was designed for Static Equilibrium conditions. Two common methods for Static Equilibrium channel design are the Permissible Velocity approach and Permissible Tractive Force approach (Refs. 5, 7). The permissible velocities recommended by ASCE Special Committee on Irrigation Research (Ref. 14) and referenced by the District's Hydraulics Manual (Ref. 9) and HDS 4 (Ref. 4) were adopted for this project. Per the recommendation (Ref. 14), the maximum permissible velocities for sandy loam and ordinary firm loam are 2.5 fps and 3.5 fps, respectively. Therefore, an average of 3.0 fps was selected as the maximum design velocity for the proposed earthen channel.

3.2 Channel Hydraulics – HEC-RAS Modeling

The HEC-RAS model (Ref. 32) was used to analyze the hydraulic performance of the proposed channel design. The HEC-RAS models cover the proposed FRS #3 outfall channel and the existing FRS # 4 inlet channel. The water surface elevation in FRS #4 reservoir during the 100-year 6-hour storm event (Ref. 40) was defined as the downstream boundary condition for the model. The HEC-RAS stationing starts with Sta 10+00 at the downstream end of FRS #4 inlet channel and increases along the channel alignment. This differs from the design stationing along Jackrabbit Trail, however, both systems are referenced with the HEC-RAS models.

It is recognized that the Manning's roughness of the channel will vary as the landscape grows and matures. Upon the completion of the construction, the Manning's roughness could be as low as 0.020. Conversely, the fully established vegetation without regular maintenance could result in a Manning's roughness as high as 0.045. Without long-term maintenance, the Manning's roughness could be increased to 0.045 or more. Three HEC-RAS models have been created as follows:

- Model 1 – Mixed Flow analysis with n=0.020
- Model 2 – Subcritical Flow analysis with n=0.035
- Model 3 – Subcritical Flow analysis with n=0.045

Model 1 is used to identify locations where hydraulic jump occurs or the velocity is higher than 3 fps. The hydraulic jumps are contained within the grade control structures, and riprap is applied where the velocity is higher than 3 fps. Model 2 is used to identify the water surface profile for the design condition. Model 3 is used to check the water surface profile and freeboard when the Manning's roughness rises to 0.045.

Cross-sections were located where geometry, roughness, or slope changes. A maximum distance of 350 feet was held between two neighboring cross-sections. Interpolated cross-sections were generated for Model 1 to identify hydraulic jumps and velocity variations.

The culvert which crosses Jackrabbit Trail between Indian School Road and Camelback Road and connects Reach 5 and 6 will be a broken-back culvert. To model the broken-back culvert in HEC-RAS, four vertical cross-sections were used along with lids to cover these sections. The culvert was also modeled using the Broken-Back Culvert Analysis Program (BCAP) (Re. 28). The BCAP results indicate that the inlet controls the upstream water surface elevation where the water surface elevation upstream is 1172.10 feet. This is close to the HEC-RAS output of 1171.60 feet at RS19620. The BCAP results also indicate a hydraulic jump occurs within the culvert. This helps dissipate energy before reaching the downstream dissipater basin. The BCAP results are included in Appendix B.

For culverts without drop inlets, the upstream water surface elevations are impacted by the shape of the entrance. To reduce entrance energy losses, all new culverts have a beveled top edge. An entrance loss coefficient of 0.2 was applied to all new culverts (Ref. 5), whereas an entrance loss coefficient of 0.5 was applied for existing culverts at Pasqualetti Mountain Ranch.

Manning's roughnesses were selected as follows:

- 0.015 for concrete channel
- 0.020 for newly constructed earthen channel
- 0.035 for earthen channel with proposed landscape
- 0.045 for earthen channel with overgrown landscape vegetation
- 0.035 for riprap
- 0.013 for concrete culverts, and a combination of CIPP pipes (0.014) and HDPE pipes (0.012)
- 0.014 for two long culverts crossing Jackrabbit Trail, to account for bend loss (Refs. 19, 20)

A Manning's roughness of 0.013 was selected for the combination of CIPP and HDPE pipes at Reach 9. Per the ADOT manual, the Manning's roughness are 0.014 and 0.012 for CIPP and HDPE, respectively, which justifies the selection of 0.013 for the combination.

A Manning's roughness of 0.035 was selected for the proposed earthen channel design and the landscape has been designed to meet the roughness requirements. Per Tables 2 and 3 of the *USGS Guidelines on Manning's Roughness* (Ref. 26), the base value of Manning's 'n' for a earthen channel is 0.020, and an adjustment of 0.015 is appropriate when trees block flow by approximately 10 percent. In the landscape design, each clump of trees will block approximately 10 percent of the flow when fully established, and the distance between two clumps is designed to be greater than three cross-section lengths to avoid the overlapping of spheres of influence.

The design discharge for Reach 9 is 285 cfs. This flow of 285 cfs combines with two major wash inflows from the west at Reach 8, resulting a combined flow of 700 cfs at the downstream end of Reach 8. To reflect the discharge variation within Reach 8, the flow rate is prorated to be 300 cfs upstream, 500 cfs downstream of the first wash, and 700 cfs downstream of the second wash (Appendix B).

The required freeboard was calculated using the equation in the *Hydraulic Manual* (Ref. 10) (Appendix B). The results indicate that sufficient freeboard has been provided for the channel with a Manning's 'n' from 0.020 to 0.045.

3.3 Reach 9 Design

One 78-inch and one 66-inch pipes are selected to convey the PMF peak flow of 285 cfs through Reach 9. This pair of pipes was proposed as a savings in the cost of HDPE pipes by nesting two pipes during transportation. Unlike the 48-inch conduit of the Primary Spillway, which requires a headwater depth of 16 feet at the inlet to convey the peak flow of 285 cfs (Appendix A), the pipe system of HDPE/CIPP combination is outlet controlled and only requires a headwater depth of 5.6 feet at the inlet. A freeboard of 1.4 feet, which is adequate, is provided upstream of the pipes.

A side weir is proposed at the left headwall of the impact basin extension. The crest of the weir is at an elevation of 1193.1 feet while the water surface elevation is 1992.8 feet. Under some emergency conditions such as the the pipes being blocked, the weir will direct flow to the wasteway.

Per the FRS3 Phase I design report (Refs. 33, 34), the capacity of the Pricinpal Spillway is basically controlled by the difference of the water surface elevation in the reservoir and the tailwater downstream of the 48-inch conduit. The tailwater is set at the the crown of the 48-inch conduit outlet, i.e. 1194.0 feet. If the water surface elevation downstream of the impact basin is higher than 1194.0 feet, then the capacity of the Principal Spillway will be reduced and the release from the Dam will be impacted. Per the HEC-RAS models, the water surface elevation downstream of the impact basin is 1192.89 feet, which is below the crown of the 48-inch conduit. Therefore, the proposed 66-inch and 78-inch pipes will not create a tailwater condition that will negatively impact the capacity of the Principal Spillway. More detailed information regarding the tailwater condition at the impact basin is located in Appendix B.

The riprap at the impact basin outlet is sized to be 20-inches (D50) to match the existing riprap, and the calculations are provided in Appnedix F.

3.4 Channel Hydraulics – Trashrack Headloss

Per the County Policy and Standard Manual (Ref. 11), it is required to install trashrack and access barrier at culverts that are bent and the opposite end cannot been clearly seen. Therefore, trashracks are proposed at Culvert #6 and Culvert #10. The headloss at trashracks were calculated assuming 50% clogged, according to the District Hydraulic Manual (Ref. 9). In the calculation, a trial approaching depth upstream of trashrack was first assumed to estimate the clogging headloss, and then the estimated headloss was used to verify the assumed approaching flow depth. The results indicate that upstream approaching flow depths at both culverts will be less than 7 feet, and a minimum freeboard of 1 foot is still available when the trashracks are 50% clogged. The calculations are included in Appendix B.

3.5 Sedimentation Analysis

The sediment yield from tributary areas was calculated using the District's DDMSW program (Beta Version 4.5.3) (Ref. 25). The DDMSW program calculates wash load using the Modified Universal Soil Loss Equation (MUSLE) method and bed load using the Zeller-Fullerton equation, as documented in the District's *River Mechanics Manual* (Ref. 13). For wash load calculations, the tributary area soils information was obtained from GIS files provided by the District (Ref. 12). For bed load calculations, the grain size distribution from the wash sand bed samples (D84=4.0mm, D50=1.2mm, and D14=0.2mm) (Ref. 1) was used. Tributary wash cross-section geometry was obtained from the one-foot contour interval topography provided by Cooper Aerial (Ref. 3). The Rational Method was used to calculate peak discharges and runoff volumes (see Section 2.8). A comparison to the HEC-1 output indicates that the Rational Method overestimates the runoff volume for large tributary areas. An adjustment factor of 0.8 was found to be appropriate and was applied to the runoff volumes from large tributary areas (Appendix C).

It should be noted that the slope lengths and percent slopes for the sediment yield calculations are different from those used for the Rational Method calculations. For the Rational Method calculations, the slope lengths and percent slopes were measured from the longest flow path. For the sediment yield calculations, the slope lengths usually refer to the travel distance of sheet flow and are required to be less than 400 feet. In this project, the slope lengths were set to be 300 feet. The percent slope for the sediment yield calculation was measured from the upstream sheet flow area, not from the longest flow path.

Four tributary washes, SF07, SF08, SF14, and SF17 (Figure C.1 and C.2 in Appendix C), were identified to be major sediment contributors. Two in-line basins will be located within Reach 8 to collect and trap sediment from SF07 and SF08. One sediment-trapping basin is located at the north end of Reach 5 to collect and trap sediment from SF17. One in-line basin will collect and trap sediment from SF14, and two 48-inch pipes downstream of the basin will divert flow across Jackrabbit Trail to Reach 6. The crest of the culvert drop inlet was set one (1) foot above the existing channel bottom. The diversion calculations are included in Appendix G.

Each sediment basin was designed with a storage volume sufficient to accommodate the tributary sediment yield from the 100-year event. Storage volume calculations are provided in Appendix C. The flow velocities at the tributary washes and sediment basins were also checked to ensure a significant velocity reduction at the basins.

3.6 Emergency Spillway Scour Analysis and Erosion Protection

One 66-inch and one 78-inch pipes will cross under the Emergency Spillway, which is currently under construction as a part of the Phase 2 Remediation (Ref. 37). A scour analysis was conducted for this crossing and the SITES (Ref. 38) model was updated by URS (Ref. 35). The general scour depth was analyzed using Blench's equation (Ref. 13) and the PMF discharge of 26,838 cfs was used (Ref.35). The bedform scour depth was calculated using the equation DDMS18 (Ref. 13) and the anti-dune height equation (Ref. 13).

The low flow scour was estimated to be one foot. The local scour depth downstream of the pipe crossing were calculated using the Zimmerman and Maniak equation (Ref. 13). In compliance with ADWR's requirement, two ways were used to estimate the total scour depth. The first one is to estimate the local scour depth with the average particle size D85 and to estimate the total scour depth with a safety factor of 1.3. The second one is to estimate the local scour depth with the minimum particle size D85 and to estimate the total scour depth with a safety factor of 1.0. The greater one of two results was selected for the erosion protection design. Three soil test pits were developed for this project at the emergency spillway, and the average and minimum D85 are 5.0 mm and 4.76 mm, respectively. The calculations are included in Appendix D, and the total scour depth is estimated to be 14.1 feet.

URS had conducted the same calculations with soil test results for the FRS#3 Remediation Project (Appendix D). Their calculations indicated a total scour depth of 19.6 feet, which resulted from a smaller minimum D85 of 0.2 mm.

To be conservative, the total scour depth of 20 feet was used for the erosion protection at the pipe crossing. The erosion measures include the upstream and downstream launchable apron and the toe protection for dikes. The launchable apron, with 7 feet thick riprap of D50=20 inches, extends 16 feet upstream and 40 feet downstream of the CIPP crossing. The dimensions were sized by the District and followed the District's Hydraulic Manual (Ref. 9). The calculations can be found in Appendix D. The toe protection for dikes are designed to the total scour depth, and riprap sizes are in compliance with the URS design. A slurry backfill and cap was selected to protect the pipes and reduce the impact of buoyancy.

3.7 Stepped Spillway Design

Stepped spillways were designed to receive flows from ten major tributary washes whose 100-year peak flows are more than 60 cfs. A riprap stilling basin was proposed immediate downstream of steps to dissipate flow energy.

Per the reference studies, two types of flow regime occur at a stepped spillway: Nappe-Flow during low discharges, and Skimming Flow during high discharges (Ref. 2, 16, 27). The side inlet structures were designed for skimming flow conditions, with the 100-year discharges. The fluid friction coefficient from Rajaratnam's study (Ref. 27) was selected to estimate the friction between skimming flow and recirculating flow trapped between steps. Calculations were conducted for typical steps with a ratio of 2.0 for horizontal length over height (Appendix E).

To identify the locations of hydraulic jump along the spillway, a momentum equation was established with some assumptions (Appendix E). Once hydraulic jump locations were identified, the stilling basin upstream flow depths were determined, as well as flow velocities within the stilling basins. Based on the estimated velocities, the ripraps within the stilling basins were sized to be 0.28 foot, however, riprap with a D50 of 18-inches was selected to protect against uncertain erosions. The lengths of the stilling basins were set to be equal to the hydraulic jump lengths which were estimated according to HEC-14 (Ref. 6). The stepped spillway calculations are included in Appendix E and riprap sizing is included in Appendix F.

3.8 Structure Seepage Analysis and Cut-Off Wall Design

The computed scour depth at box culverts and downstream of grade control structures was used to identify the design depth for cut-off walls (Appendix F). The scour depths are calculated to be less than five (5) feet and cut-off walls of four (4) and six (6) feet are typically used at the upstream and downstream ends of the structures.

Lane's Weighted-Creep method (Ref. 9) was used to analyze the seepage potential and piping risk along structure foundations. The calculations provided in Appendix F indicate that the 4-foot and 6-foot cut-off walls will effectively prevent potential seepage flow under the box culverts and grade control structures, however deeper cut-off walls are required for stepped spillways.

3.9 Diversion at Litchfield Heights

Flow which approaches Jackrabbit Trail from the west within an existing drainage path through the Litchfield Heights development (Reach 6) will be conveyed across Jackrabbit Trail to the channel via two 48-inch pipes. Flow split calculations were performed to determine the amount of flow that will be diverted through the culvert, versus flow that will continue south within the existing channel along the west side of Jackrabbit Trail. The capacities of the pipes and the existing channel at various water surface elevations were calculated and presented in Appendix G. The drop inlet structure on the box culvert was sized such that when a 100-year peak flow of 556 cfs approaches, 256 cfs will be diverted east across Jackrabbit Trail to the proposed channel, and the remaining flow of 300 cfs will continue to the south, fully contained within the existing channel.

3.10 Wasteway Flows to Beardsley Canal and Wash

One of the two Principal Spillway pipes (east pipe), i.e. the gated outlet, will remain for use as an emergency wasteway. This wasteway will only be used if the operation of FRS#4 does not allow a discharge or if construction of the outfall channel is incomplete.

The inundation effects from the wasteway outflow were analyzed and mapped (Figure 4). The wasteway discharge of 221 cfs from the gated outlet occurs when the water surface elevation in the FRS#3 reservoir reaches the crest of the emergency spillway, i.e. 1,212 feet (NAVD 88) (Appendix A). Under this condition, no flow will be discharged from the emergency spillway, and the downstream flood inundation will be dominated by the discharge of 221 cfs.

The flow depths from the normal depth calculations were used to identify the inundation area along the wasteway between the impact basin and Beardsley Wash. The flow depths for a typical wasteway cross-sections with 14-feet bottom width and 2.5-10:1 side slopes vary from 1.9 feet to 2.5 feet. The inundation along the wasteway was identified based on the estimated flow depth range and the proposed grading at along the wasteway. The normal depth calculation and the inundation are included in Appendix H.

A steady flow HEC-RAS model was prepared for the inundation along Beardsley Wash. Cross-section geometries were obtained from the one-foot aerial mapping prepared by Cooper Aerial in December 2009. Cross-sections were located along the wash every 200 feet, except at the Beardsley Canal overchute and where trails cross the wash. Ineffective flow areas were identified at some cross-sections where water can pond. Due to the density of the existing vegetation, a Manning's 'n' roughness coefficient of 0.045 was chosen for the entire wash along the Beardsley Canal. The justification of Manning's 'n' selection is provided in Appendix H.

The HEC-RAS model output is also included in Appendix H. Results from the normal depth calculations and the HEC-RAS model were used to delineate the inundation area shown in Figure 4. The potential flood inundation area occurs along the west side of the Beardsley Canal, southward toward an overchute that is located south of Bethany Home Road.

3.11 Riprap Sizing

Riprap sizing is according to the *River Mechanics Manual* (Ref. 13) and HEC-14 (Ref. 6). Three sizes are selected, D50= 9 inches, 18 inches and 20 inches.

Riprap of D50=9 inches is applied at grade control structures, culverts, the stilling basins of stepped spillways, the storm drain oulet collecting off-site drainage, and the impact basin at Reach 9.

Riprap of D50=18 inches is applied at the stiling basins of stepped spillway and the slope of the silt basin at Station 244+00.

Riprap of D50=20 inches is applied at the emergency spillway to protect the CIPP pipe crossing.

The calculations are provided in Appendix F.

FIGURE 4 – WASTEWAY FLOW INUNDATION AREA

4 CONCLUSIONS

This report accompanies the Final Design Submittal for the project and provides details for the hydrologic and hydraulic design.

4.1 Hydrology

The hydrologic documentation from the 30% Design Report (Refs. 19, 20), the 60% Drainage Report and the 95% Drainage Report have been consolidated within this Final Drainage Report.

4.2 Hydraulics

The results from the Geotechnical Report (Ref. 1) justify that velocities up to 3 fps are non-erosive. The channel was designed with a slope of 0.0010 ft/ft, for all reaches except Reach 7. In Reach 7, the channel is narrower so that the slope was flattened to 0.0007 ft/ft to achieve the non-erosive velocity of 3 fps.

Three HEC-RAS models were provided for the channel to check for maximum velocities and to ensure flood containment. For the post-construction condition, a Manning's 'n' value of 0.020 was selected with a mixed-flow regime. For the design condition, subcritical flow with a Manning's 'n' value of 0.035 was assumed to represent established vegetation. For an overgrown and less maintained condition, a Manning's 'n' roughness value of 0.045 was assumed and used to check the minimum freeboard.

Sediment basins have been provided at four major tributary wash inflows to the channel. These basins were sized for the sediment yield resulting from the 100-year event. One 78-inch pipe and one 66-inch pipe will convey flow from the Principal Spillway across the Emergency Spillway. To protect against scour from the Emergency Spillway flows, a launchable riprap apron and riprap toe protection for dikes were designed. Stepped spillways were designed to receive tributary washes, to dissipate the energy of side flows, and to fully contain potential hydraulic jumps. Seepage analysis was conducted to justify cut-off wall depths and prevent potential seepage flow and piping under structure's foundations.

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APPENDIX A – HYDROLOGIC MODELING

A.1 SCHEMATIC MAPS

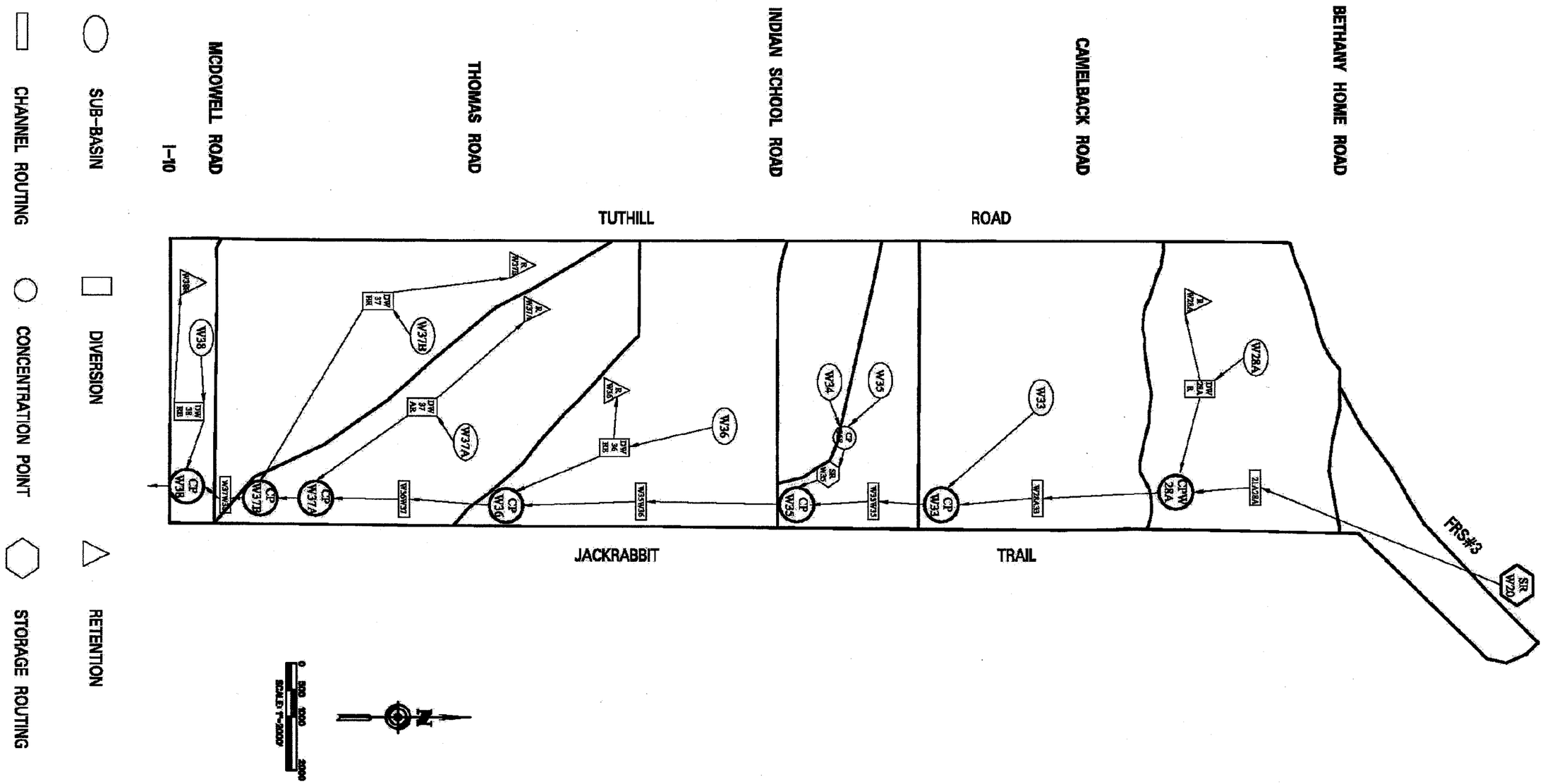

FIGURE A.1 – SCHEMATIC MAP FOR JACKRABBIT CORRIDOR HEC-1 MODEL, FUTURE CONDITION WITH PROJECT-IN-PLACE

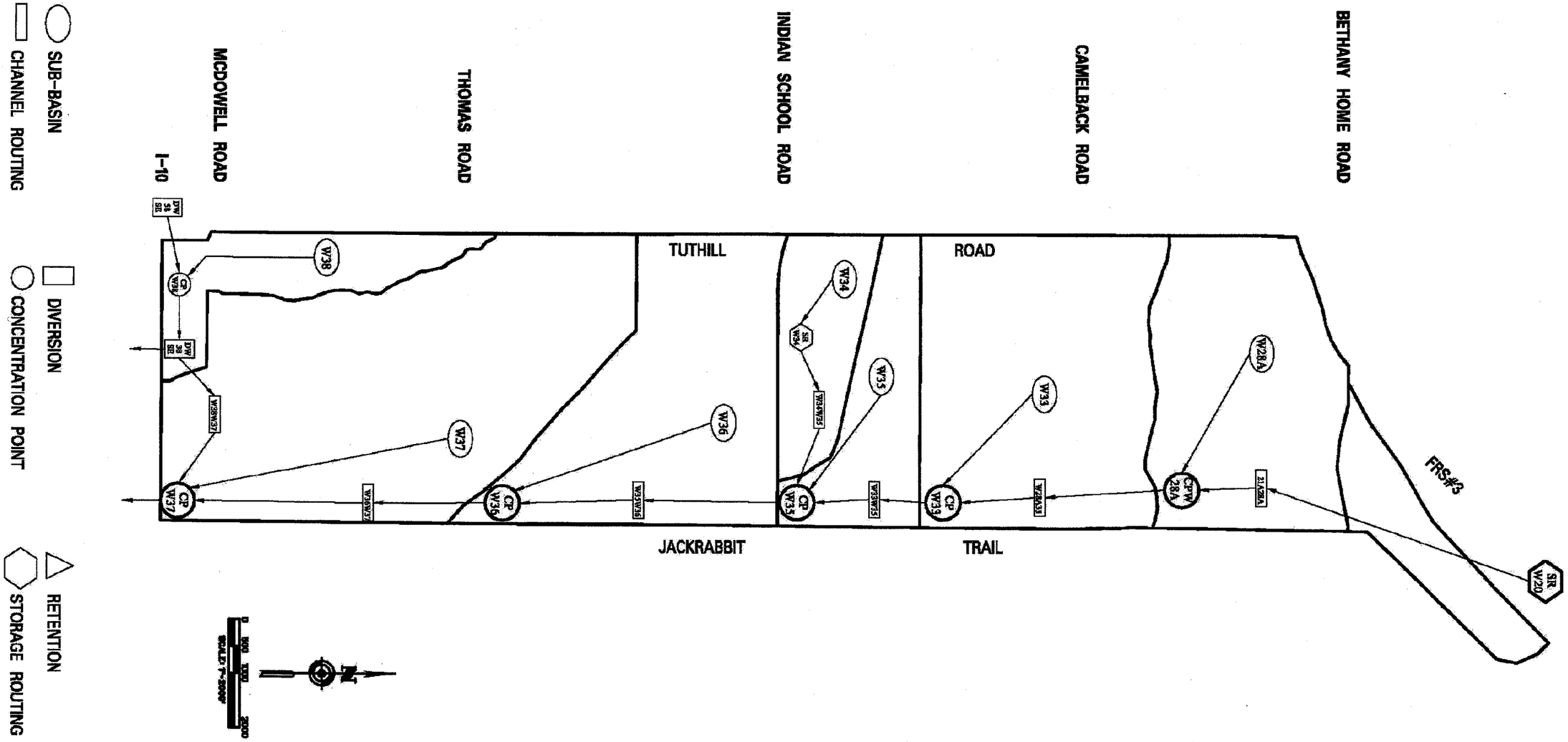

FIGURE A.2 – SCHEMATIC MAP FOR JACKRABBIT CORRIDOR HEC-1 MODEL, EXISTING CONDITION WITH PROJECT IN PLACE

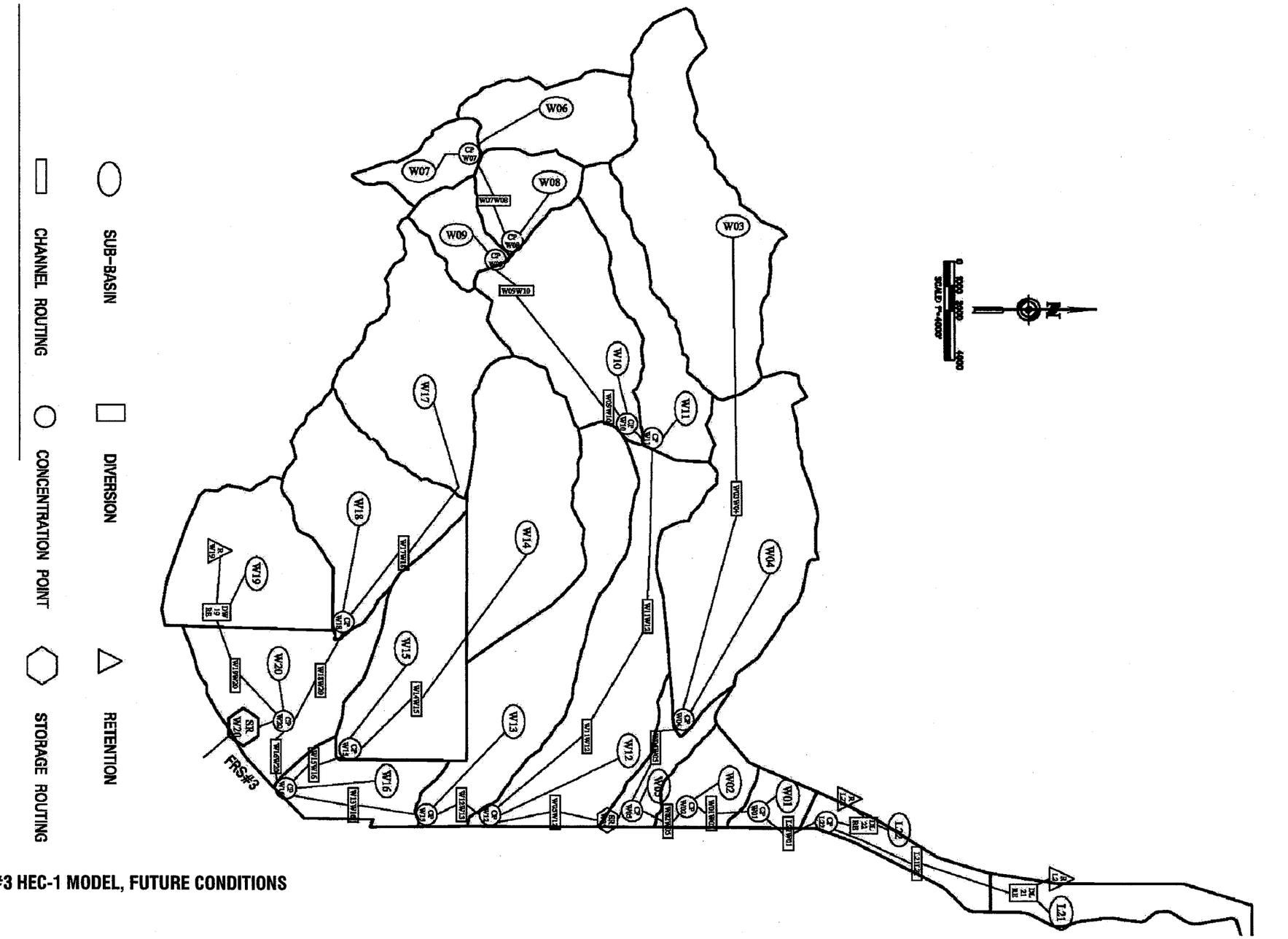

FIGURE A.3 – SCHEMATIC MAP FOR FRS#3 HEC-1 MODEL, FUTURE CONDITIONS

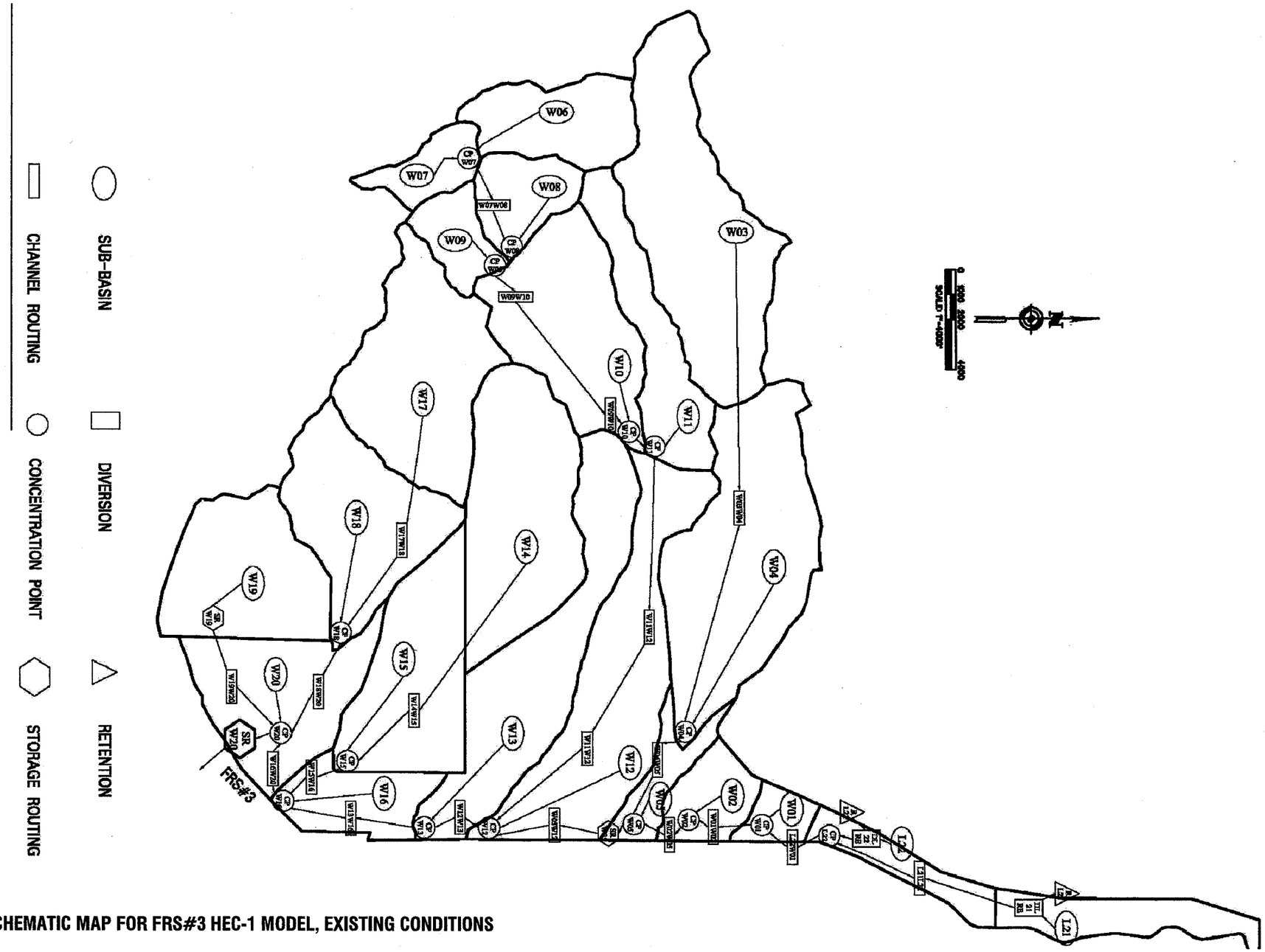

FIGURE A.4 – SCHEMATIC MAP FOR FRS#3 HEC-1 MODEL, EXISTING CONDITIONS

A.2 FUTURE CONDITIONS WITH PROJECT IN PLACE, 10-YEAR FOR JACKRABBIT CORIDDOR

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1****************************************           ****************************************
 *                                      *           *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *           *    U.S. ARMY CORPS OF ENGINEERS      *
 *             JUN   1998               *           *    HYDROLOGIC ENGINEERING CENTER     *
 *           VERSION 4.1                *           *          609 SECOND STREET           *
 *                                      *           *       DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   03APR10  TIME  12:51:30  *           *          (916) 756-1104              *
 *                                      *           *                                      *
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                 X     X  XXXXXXX   XXXXX          X
                 X     X  X        X     X        XX
                 X     X  X        X               X
                 XXXXXXX  XXXX     X       XXXXX   X
                 X     X  X        X               X
                 X     X  X        X     X         X
                 X     X  XXXXXXX   XXXXX         XXX


THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM


1                                        HEC-1 INPUT                                        PAGE  1

 LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

   1           ID           FUTURE CONDITION 10-YEAR 24HOUR EVENT
   2           ID           PRECIPITATION FROM DDMSW
   3           ID           WHITE TANKS AREA, WATERSHED CONTRIBUTING TO FRS#3
   4           ID           PREPARED BY HOSKIN RYAN CONSULTANTS EXCLUSIVELY FOR
   5           ID           FRS#3 OUTLET CHANNEL DESIGN, 04-01-2010
   6           ID           BASED ON HDR HEC-1 MODEL OF FUTURE CONDITION WITH CIP
   7           ID           MODIFICATIONS INCLUDE:
   8           ID           (1) UPDATE WITH AVERAGE RAINFALL DEPTH FOR JACKRABBIT CORRIDOR
   9           ID           (2) DELETE BASIN W21A DUE TO THE ADOPTION OF PIPE AT REACH 9
  10           ID           (3) ADD RETENTION DIVERSION FOR W28A
  11           ID           (4) REMOVE RETENTION DIVERSION FOR W33
  12           ID           (5) UPDATE VERRADO DEVELOPMENT FOR W34 AND W35
  13           ID           (6) UPDATE RETENTION FOR W36 AND W37 (ARROYO SECO DEVELOPMENT)
  14           ID           (7) DIVIDE BASIN W37 INTO W37A AND W37B
  15           ID           (8) UPDATE PROPOSED CHANNEL ALONG JACKRABBIT TRAIL
  16           ID           **************************************************************
  17           ID        Flood Control District of Maricopa County
  18           ID        FU_CIP_MB02 - Loop 303/ White Tanks ADMPU AHA
  19           ID        Major Basin: 02
  20           ID        100 Year - Return Period
  21           ID        24 Hour Storm
  22           ID        Multiple Storms
  23           ID        Unit Hydrograph: S-Graph
  24           ID        03/08/2009
  25           IT       5  1JAN99    1200    2000
  26           IN      15
  27           IO       5
               *DIAGRAM
               *
  28           JD   2.353  0.0001
  29           PC   0.000   0.002   0.005   0.008   0.011   0.014   0.017   0.020   0.023   0.026
  30           PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056   0.060
  31           PC   0.064   0.068   0.072   0.076   0.080   0.085   0.090   0.095   0.100   0.105
  32           PC   0.110   0.115   0.120   0.126   0.133   0.140   0.147   0.155   0.163   0.172
  33           PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
  34           PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
  35           PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
  36           PC   0.913   0.918   0.922   0.926   0.930   0.934   0.938   0.942   0.946   0.950
  37           PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977   0.980
  38           PC   0.983   0.986   0.989   0.992   0.995   0.998   1.000
  39           JD   2.235    10.0
               *

  40           KK     WT3
  41           KM   OUTFLOW FROM WT FRS#3 OUTLET
  42           BA   21.52
  43           KO       5
  44           ZR  =QI A=WT B=FRS3 C=FLOW
               *
1                                        HEC-1 INPUT                                        PAGE  2

 LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10
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  45           KK  21A28A   ROUTE
  46           KM   PROPOSED JACKRABBIT CHANNEL, BOTTOM WIDTH=30FT, SIDE SLOPE 6:1
  47           ZW   A=WT B=21A28A C=FLOW
  48           RS       4    FLOW      -1
  49           RC   0.045   0.035   0.045    3560  0.0010
  50           RX     100     110     120     150     180     210     220     230
  51           RY    1001    1000    1000     995     995    1000    1000    1001
               *

  52           KK    W28A   BASIN
  53           BA   0.642
  54           LG    0.26    0.25    4.55    0.41      22
  55           UI       0      85     281     456     611     978     845     622     457     266
  56           UI     145      96      47      26      26      27       0       0       0       0
  57           UI       0       0       0       0       0       0       0       0       0       0
  58           UI       0       0       0       0       0       0       0       0       0       0
  59           UI       0       0       0       0       0       0       0       0       0       0
               *

  60           KK  DW28AR
  61           KM   FUTURE DEVELOPMENT ON 301AC VACANT LAND OF MARACAY, 80% RETENTION VOLUME ASSU
  62           KM   (C=0.65)(P=2.3IN)
  63           ZW   A=WT B=DW28AR C=FLOW
  64           DT   RW28A    30.0
  65           DI       0   10000
  66           DQ       0   10000
               *

  67           KK  CPW28A COMBINE
  68           ZW   A=WT B=CPW28A C=FLOW
  69           HC       2   0.841
               *

  70           KK  W28A33   ROUTE
  71           KM   PROPOSED JACKRABBIT CHANNEL, BOTTOM WIDTH=40FT, SIDE SLOPE 4:1
  72           ZW   A=WT B=W28A33 C=FLOW
  73           RS       5    FLOW      -1
  74           RC   0.045   0.035   0.045    4336  0.0010
  75           RX     100     110     120     140     180     200     210     220
  76           RY    1001    1000    1000     995     995    1000    1000    1001
               *

  77           KK     W33   BASIN
  78           ZW   A=WT B=W33 C=FLOW
  79           BA   0.839
  80           LG    0.30    0.25    4.00    0.55      15
  81           UI       0      96     254     469     595     819    1172     911     714     530
  82           UI     367     191     142      97      37      29      30      29       0       0
  83           UI       0       0       0       0       0       0       0       0       0       0
  84           UI       0       0       0       0       0       0       0       0       0       0
  85           UI       0       0       0       0       0       0       0       0       0       0
               *
1                                        HEC-1 INPUT                                        PAGE  3

 LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  86           KK   CPW33 COMBINE
  87           ZW   A=WT B=CPW33 C=FLOW
  88           HC       2    1.68
               *

  89           KK  W33W35   ROUTE
  90           KM   PROPOSED JACKRABBIT CHANNEL, BOTTOM WIDTH=40FT, SIDE SLOPE 6:1
  91           ZW   A=WT B=W33W35 C=FLOW
  92           RS       3    FLOW      -1
  93           RC   0.045   0.035   0.045    2658  0.0010
  94           RX     100     110     116     152     192     228     240     250
  95           RY    1001    1000    1000     994     994    1000    1000    1001
               *
               * UPDATE VERRADO DEVELOPMENT AT INDIAN SCHOOL AND JACKRABBIT TRAIL RD
               * PER VERRADO MASTER DRAINAGE PLAN PREPARED BY WOOD PATEL. THE SCHOOL
               * SITE (~0.184 SQ MI) COULD RETAIN 100-YR 24-HR RAINFALL, THEREFORE IS
               * REMOVED FROM HEC-1 MODEL AS NON-CONTRIBUTING AREA, PER VERRADO MDP.
               *

  96           KK     W34
  97           KM    THE FOLLOWING PARAMETERS WERE PROVIDED FOR THIS BASIN
  98           KM    L=       .78  Lca=       .35   S=   69.7  Kn= .054  LAG=     21
  99           KM    PHOENIX VALLEY S-GRAPH WAS USED FOR THIS BASIN
 100           BA    .238
 101           LG     .25     .25    3.95     .58      31
 102           UI      40     161     238     384     397     267     176      80      48      22
 103           UI      12      12      0.      0.      0.      0.      0.      0.      0.      0.
 104           UI      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
               *

 105           KK     W35
 106           KM    THE FOLLOWING PARAMETERS WERE PROVIDED FOR THIS BASIN
 107           KM    L=    0.860  Lca=       .32   S=   49.2  Kn= .054  LAG=     23
 108           KM    PHOENIX VALLEY S-GRAPH WAS USED FOR THIS BASIN
 109           BA    .089
 110           LG     .25     .25    3.95     .57      25
 111           UI      13      50      75     108     155     108      76      50      22      14
```

```
112        UI      7.      4.      4.      0.      0.      0.      0.      0.      0.      0.
113        UI      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
           *

114        KK   CP35R
115        KM        ADD HYDROGRAPHS AT SRW35
116        HC       2
           *

117        KK   SRW35
118        KM        RET BASIN AT CP30 - 54' WEIR OUTFALL
119        ZW   A=WT B=SRW35 C=FLOW
120        RS       1    STOR       0       0
121        SV       0    3.67    7.67   12.21   17.26   19.89   22.59   25.36   28.21
122        SE    1153    1154    1155    1156    1157  1157.5    1158  1158.5    1159
123        SQ     0.1    0.11    0.12    0.13    0.14    0.15    0.15   50.21  142.02
           *
1                                        HEC-1 INPUT                                          PAGE  4

LINE       ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

124        KK   CPW35
125        KM        ADD HYDROGRAPHS AT JACKRABBIT TRAIL AND INDIAN SCHOOL RD
126        ZW   A=WT B=CPW35 C=FLOW
127        HC       2
           *

128        KK  W35W36   ROUTE
129        KM   PROPOSED JACKRABBIT CHANNEL, BOTTOM WIDTH=40FT, SIDE SLOPE 4:1
130        ZW   A=WT B=W35W36 C=FLOW
131        RS       7    FLOW      -1
132        RC   0.045   0.035   0.045    6051  0.0010
133        RX     100     110     116     140     180     204     220     230
134        RY    1001    1000    1000     994     994    1000    1000    1001
           *

135        KK     W36   BASIN
136        BA   0.720
137        LG    0.30    0.25    4.00    0.55      15
138        UI       0      75     166     331     432     543     773     886     660     517
139        UI     403     292     150     125      75      48      23      23      23      23
140        UI       0       0       0       0       0       0       0       0       0       0
141        UI       0       0       0       0       0       0       0       0       0       0
142        UI       0       0       0       0       0       0       0       0       0       0
           *

143        KK  DW36RE  DIVERT
144        KM   ARROYO SECO FUTURE DEVELOPMENT HOLDS 127AC VACANT LAND IN BASIN W36. ASSUME 8
145        KM   100-YEAR 2-HOUR RETENTION. (C=0.65)(P=2.3IN). PASSQUALITY MOUNTAIN RANCH
146        KM   PROVIDES A DETENTION BASIN OF NEGLIGIBLE SIZE AND NO RETENTION.
147        ZW   A=WT B=DW36RE C=FLOW
148        DT    RW36    12.7
149        DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
150        DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
           *

151        KK   CPW36 COMBINE
152        ZW   A=WT B=CPW36 C=FLOW
153        HC       2   2.911
           *

154        KK  W36W37   ROUTE
155        KM   PROPOSED JACKRABBIT CHANNEL, BOTTOM WIDTH=30FT, SIDE SLOPE 4:1
156        ZW   A=WT B=W36W37 C=FLOW
157        RS       5    FLOW      -1
158        RC   0.045   0.035   0.045    4527  0.0010
159        RX     100     110     122     150     178     210     220     230
160        RY    1001    1000    1000     993     993    1000    1000    1001
           *
1                                        HEC-1 INPUT                                          PAGE  5

LINE       ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

161        KK    W37A
162        KM    LG VARIABLE VALUES FROM HDR MODEL.
163        KM    THE FOLLOWING PARAMETERS WERE PROVIDED FOR THIS BASIN
164        KM    L=      1.9  Lca=      1.0   S=   60.1  Kn= .034  LAG=  28.5
165        KM    PHOENIX VALLEY S-GRAPH WAS USED FOR THIS BASIN
166        BA     .63
167        LG     .29     .25    4.30     .48   19.00
168        UI     74.    203.    370.    478.    657.    903.    674.    517.    388.    244.
169        UI    128.     96.     62.     23.     23.     23.     23.      0.      0.      0.
170        UI      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
           *

171        KK  DW37AR  DIVERT
172        KM   ARROYO SECO FUTURE DEVELOPMENT HOLDS 162AC VACANT LAND IN BASIN W37A. ASSUME
173        KM   80% 100-YEAR 2-HOUR RETENTION. (C=0.65)(P=2.3IN). THE SOUTH SUBDIVIION IN
174        KM   BASIN W37A DOES NOT PROVIDE RETENTION.
175        ZW   A=WT B=DW37AR C=FLOW
176        DT   RW37A    16.1
177        DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
178        DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
           *

179        KK  CPW37A COMBINE
180        ZW   A=WT B=CPW37A C=FLOW
181        HC       2   3.541
           *

182        KK    W37B
183        KM    LG VARIABLE VALUES FROM HDR MODEL.
184        KM    THE FOLLOWING PARAMETERS WERE PROVIDED FOR THIS BASIN
185        KM    L=      2.0  Lca=      1.0   S=   59.2  Kn= .034  LAG=  28.7
186        KM    PHOENIX VALLEY S-GRAPH WAS USED FOR THIS BASIN
187        BA     .67
188        LG     .29     .25    4.30     .48   19.00
189        UI     79.    214.    390.    503.    686.    962.    720.    553.    416.    270.
190        UI    137.    105.     69.     24.     24.     24.     24.      0.      0.      0.
191        UI      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
           *

192        KK  DW37BR  DIVERT
193        KM   ARROYO SECO FUTURE DEVELOPMENT HOLDS 30AC VACANT LAND IN BASIN W37B. ASSUME
194        KM   80% 100-YEAR 2-HOUR RETENTION. (C=0.65)(P=2.3IN). THE SOUTH SUBDIVIION IN
195        KM   BASIN W37B DOES NOT PROVIDE RETENTION.
196        ZW   A=WT B=DW37BR C=FLOW
197        DT   RW37B     3.0
198        DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
199        DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
           *
1                                        HEC-1 INPUT                                          PAGE  6

LINE       ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

200        KK  CPW37B COMBINE
201        ZW   A=WT B=CPW37B C=FLOW
202        HC       2   4.214
           *

203        KK  W37W38   ROUTE
204        ZW   A=WT B=W37W38 C=FLOW
205        RS       1    FLOW      -1
206        RC   0.015   0.015   0.015     833  0.0015    0.00
207        RX  100.00  105.00  109.00  125.00  135.00  151.00  155.00  160.00
208        RY  1000.0  999.50  999.00  995.00  995.10  999.00  999.50 1000.00
           *

209        KK     W38   BASIN
210        BA   0.163
211        LG    0.10    0.25    4.15    0.59      84
212        UI       0      72     224     403     305     162      58      21      11       0
213        UI       0       0       0       0       0       0       0       0       0       0
214        UI       0       0       0       0       0       0       0       0       0       0
215        UI       0       0       0       0       0       0       0       0       0       0
216        UI       0       0       0       0       0       0       0       0       0       0
           *

217        KK  DW38RE  DIVERT
218        KM   ASSUME 80% 100-YEAR 2-HOUR RETENTION. (C=0.65)(P=2.3IN).
219        ZW   A=WT B=DW38RE C=FLOW
220        DT    W38R    10.4     0.0
221        DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
222        DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
           *

223        KK   CPW38 COMBINE
224        ZW   A=WT B=CPW38 C=FLOW
225        HC       2   4.377
           *
226        ZZ
1
                 SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
 LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

  40          WT3
                V
                V
  45       21A28A
                .
                .
  52            .        W28A
                .          .
                .          .
  64            .          .-------->   RW28A
  60            .      DW28AR
                .          .
                .          .
  67       CPW28A............
                V
                V
  70       W28A33
                .
                .
```

```
 77          .        W33
             .          .
             .          .
 86      CPW33...........
             V
             V
 89      W33W35
             .
             .
 96          .        W34
             .          .
             .          .
105          .          .        W35
             .          .          .
             .          .          .
114          .      CP35R...........
             .          V
             .          V
117          .      SRW35
             .          .
             .          .
124      CPW35...........
             V
             V
128      W35W36
             .
             .
135          .        W36
             .          .
             .          .
148          .          .-------->   RW36
143          .     DW36RE
             .          .
             .          .
151      CPW36...........
             V
             V
154      W36W37
             .
             .
161          .       W37A
             .          .
             .          .
176          .          .-------->   RW37A
171          .     DW37AR
             .          .
             .          .
179      CPW37A..........
             .
             .
182          .       W37B
             .          .
             .          .
197          .          .-------->   RW37B
192          .     DW37BR
             .          .
             .          .
200      CPW37B..........
             V
             V
203      W37W38
             .
             .
209          .        W38
             .          .
             .          .
220          .          .-------->   W38R
217          .     DW38RE
             .          .
             .          .
223      CPW38...........
```

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
	HYDROGRAPH AT									
+		WT3	81.	22.17	80.	64.	28.	21.52		
	ROUTED TO									
+		21A28A	81.	22.67	80.	64.	28.	21.52		
	HYDROGRAPH AT									
+		W28A	372.	12.33	44.	13.	5.	.64		
	DIVERSION TO									
+		RW28A	372.	12.33	44.	13.	5.	.64		
	HYDROGRAPH AT									
+		DW28AR	0.	.00	0.	0.	0.	.64		
	2 COMBINED AT									
+		CPW28A	81.	22.67	80.	64.	28.	.84		
	ROUTED TO									
+		W28A33	81.	23.25	80.	64.	28.	.84		
	HYDROGRAPH AT									
+		W33	363.	12.42	44.	13.	4.	.84		
	2 COMBINED AT									
+		CPW33	360.	12.42	82.	69.	33.	1.68		
	ROUTED TO									
+		W33W35	302.	12.67	82.	68.	33.	1.68		
	HYDROGRAPH AT									
+		W34	153.	12.25	18.	6.	2.	.24		
	HYDROGRAPH AT									
+		W35	52.	12.25	6.	2.	1.	.09		
	2 COMBINED AT									
+		CP35R	205.	12.25	24.	8.	3.	.33		
	ROUTED TO									
+		SRW35	0.	21.33	0.	0.	0.	.33		
	2 COMBINED AT									
+		CPW35	302.	12.67	82.	68.	33.	2.01		
	ROUTED TO									
+		W35W36	219.	13.33	82.	68.	33.	2.01		
	HYDROGRAPH AT									
+		W36	293.	12.50	38.	11.	4.	.72		
	DIVERSION TO									
+		RW36	278.	12.42	23.	6.	2.	.72		
	HYDROGRAPH AT									
+		DW36RE	207.	12.67	18.	5.	2.	.72		
	2 COMBINED AT									
+		CPW36	241.	13.25	83.	72.	34.	2.91		
	ROUTED TO									
+		W36W37	214.	13.75	83.	71.	34.	2.91		
	HYDROGRAPH AT									
+		W37A	312.	12.33	39.	12.	4.	.63		
	DIVERSION TO									
+		RW37A	312.	12.33	30.	8.	3.	.63		
	HYDROGRAPH AT									
+		DW37AR	122.	12.67	12.	4.	1.	.63		
	2 COMBINED AT									
+		CPW37A	223.	13.75	84.	74.	36.	3.54		
	HYDROGRAPH AT									
+		W37B	330.	12.33	41.	13.	4.	.67		
	DIVERSION TO									
+		RW37B	8.	10.58	4.	2.	1.	.67		
	HYDROGRAPH AT									
+		DW37BR	330.	12.33	41.	11.	4.	.67		
	2 COMBINED AT									
+		CPW37B	329.	12.33	108.	83.	39.	4.21		
	ROUTED TO									
+		W37W38	321.	12.33	108.	83.	39.	4.21		
	HYDROGRAPH AT									
+		W38	198.	12.17	25.	9.	3.	.16		
	DIVERSION TO									
+		W38R	198.	12.17	18.	5.	2.	.16		
	HYDROGRAPH AT									
+		DW38RE	92.	12.33	11.	3.	1.	.16		
	2 COMBINED AT									
+		CPW38	397.	12.33	118.	86.	40.	4.38		

*** NORMAL END OF HEC-1 ***

A.3 FUTURE CONDITIONS WITH PROJECT IN PLACE, 100-YEAR FOR JACKRABBIT CORRIDOR

```
1***************************************                    ***************************************
 *                                     *                    *                                     *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1) *                    *    U.S. ARMY CORPS OF ENGINEERS     *
 *              JUN   1998             *                    *    HYDROLOGIC ENGINEERING CENTER    *
 *            VERSION 4.1              *                    *          609 SECOND STREET          *
 *                                     *                    *       DAVIS, CALIFORNIA 95616       *
 *  RUN DATE   03APR10  TIME  12:32:35 *                    *           (916) 756-1104            *
 *                                     *                    *                                     *
 ***************************************                    ***************************************


                      X       X  XXXXXXX   XXXXX           X
                      X       X  X        X     X         XX
                      X       X  X        X                X
                      XXXXXXX    XXXX     X        XXXXX   X
                      X       X  X        X                X
                      X       X  X        X     X          X
                      X       X  XXXXXXX   XXXXX          XXX


  THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

  THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
  THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
  NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
  DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
  KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM
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1                                   HEC-1 INPUT                                        PAGE  1

  LINE      ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

     1      ID           WHITE TANKS AREA, WATERSHED CONTRIBUTING TO FRS#3
     2      ID           PREPARED BY HOSKIN RYAN CONSULTANTS EXCLUSIVELY FOR
     3      ID           FRS#3 OUTLET CHANNEL DESIGN, 04-01-2010
     4      ID           BASED ON HDR HEC-1 MODEL OF FUTURE CONDITION WITH CIP
     5      ID           MODIFICATIONS INCLUDE:
     6      ID           (1) UPDATE WITH AVERAGE RAINFALL DEPTH FOR JACKRABBIT CORRIDOR
     7      ID           (2) DELETE BASIN W21A DUE TO THE ADOPTION OF PIPE AT REACH 9
     8      ID           (3) ADD RETENTION DIVERSION FOR W28A
     9      ID           (4) REMOVE RETENTION DIVERSION FOR W33
    10      ID           (5) UPDATE VERRADO DEVELOPMENT FOR W34 AND W35
    11      ID           (6) UPDATE RETENTION FOR W36 AND W37 (ARROYO SECO DEVELOPMENT)
    12      ID           (7) DIVIDE BASIN W37 INTO W37A AND W37B
    13      ID           (8) UPDATE PROPOSED CHANNEL ALONG JACKRABBIT TRAIL
    14      ID           *********************************************************
    15      ID         Flood Control District of Maricopa County
    16      ID         FU_CIP_MB02 - Loop 303/ White Tanks ADMPU AHA
    17      ID         Major Basin: 02
    18      ID         100 Year - Return Period
    19      ID         24 Hour Storm
    20      ID         Multiple Storms
    21      ID         Unit Hydrograph: S-Graph
    22      ID         03/08/2009
    23      IT       5  1JAN99    1200    2000
    24      IN      15
    25      IO       5
            *DIAGRAM
            *
    26      JD   3.661  0.0001
    27      PC   0.000   0.002   0.005   0.008   0.011   0.014   0.017   0.020   0.023   0.026
    28      PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056   0.060
    29      PC   0.064   0.068   0.072   0.076   0.080   0.085   0.090   0.095   0.100   0.105
    30      PC   0.110   0.115   0.120   0.126   0.133   0.140   0.147   0.155   0.163   0.172
    31      PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
    32      PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
    33      PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
    34      PC   0.913   0.918   0.922   0.926   0.930   0.934   0.938   0.942   0.946   0.950
    35      PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977   0.980
    36      PC   0.983   0.986   0.989   0.992   0.995   0.998   1.000
    37      JD   3.478    10.0
            *

    38      KK     WT3
    39      KM   OUTFLOW FROM WT FRS#3 OUTLET
    40      BA   21.52
    41      KO       5
    42      ZR  =QI A=WT B=FRS3 C=FLOW
            *

    43      KK  21A28A   ROUTE
    44      KM   PROPOSED JACKRABBIT CHANNEL, BOTTOM WIDTH=30FT, SIDE SLOPE 6:1
    45      ZW   A=WT B=21A28A C=FLOW
    46      RS       4    FLOW      -1
    47      RC   0.045   0.035   0.045    3560  0.0010
    48      RX     100     110     120     150     180     210     220     230
    49      RY    1001    1000    1000     995     995    1000    1000    1001
            *
```

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1                                   HEC-1 INPUT                                        PAGE  2

  LINE      ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

    50      KK    W28A   BASIN
    51      BA   0.642
    52      LG    0.26    0.25    4.55    0.41      22
    53      UI       0      85     281     456     611     978     845     622     457     266
    54      UI     145      96      47      26      26      27       0       0       0       0
    55      UI       0       0       0       0       0       0       0       0       0       0
    56      UI       0       0       0       0       0       0       0       0       0       0
    57      UI       0       0       0       0       0       0       0       0       0       0
            *

    58      KK  DW28AR
    59      KM   FUTURE DEVELOPMENT ON 301AC VACANT LAND OF MARACAY, 80% RETENTION VOLUME ASSU
    60      KM   (C=0.65)(P=2.3IN)
    61      ZW   A=WT B=DW28AR C=FLOW
    62      DT   RW28A    30.0
    63      DI       0   10000
    64      DQ       0   10000
            *

    65      KK  CPW28A COMBINE
    66      ZW   A=WT B=CPW28A C=FLOW
    67      HC       2   0.841
            *

    68      KK  W28A33   ROUTE
    69      KM   PROPOSED JACKRABBIT CHANNEL, BOTTOM WIDTH=40FT, SIDE SLOPE 4:1
    70      ZW   A=WT B=W28A33 C=FLOW
    71      RS       5    FLOW      -1
    72      RC   0.045   0.035   0.045    4336  0.0010
    73      RX     100     110     120     140     180     200     210     220
    74      RY    1001    1000    1000     995     995    1000    1000    1001
            *

    75      KK     W33   BASIN
    76      ZW   A=WT B=W33 C=FLOW
    77      BA   0.839
    78      LG    0.30    0.25    4.00    0.55      15
    79      UI       0      96     254     469     595     819    1172     911     714     530
    80      UI     367     191     142      97      37      29      30      29       0       0
    81      UI       0       0       0       0       0       0       0       0       0       0
    82      UI       0       0       0       0       0       0       0       0       0       0
    83      UI       0       0       0       0       0       0       0       0       0       0
            *

    84      KK   CPW33 COMBINE
    85      ZW   A=WT B=CPW33 C=FLOW
    86      HC       2    1.68
            *
```

```
1                                   HEC-1 INPUT                                        PAGE  3

  LINE      ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

    87      KK  W33W35   ROUTE
    88      KM   PROPOSED JACKRABBIT CHANNEL, BOTTOM WIDTH=40FT, SIDE SLOPE 6:1
    89      ZW   A=WT B=W33W35 C=FLOW
    90      RS       3    FLOW      -1
    91      RC   0.045   0.035   0.045    2658  0.0010
    92      RX     100     110     116     152     192     228     240     250
    93      RY    1001    1000    1000     994     994    1000    1000    1001
            *
            * UPDATE VERRADO DEVELOPMENT AT INDIAN SCHOOL AND JACKRABBIT TRAIL RD
            * PER VERRADO MASTER DRAINAGE PLAN PREPARED BY WOOD PATEL. THE SCHOOL
            * SITE (~0.184 SQ MI) COULD RETAIN 100-YR 24-HR RAINFALL, THEREFORE IS
            * REMOVED FROM HEC-1 MODEL AS NON-CONTRIBUTING AREA, PER VERRADO MDP.
            *

    94      KK     W34
    95      KM    THE FOLLOWING PARAMETERS WERE PROVIDED FOR THIS BASIN
    96      KM    L=      .78  Lca=      .35   S=   69.7  Kn= .054  LAG=    21
    97      KM    PHOENIX VALLEY S-GRAPH WAS USED FOR THIS BASIN
    98      BA    .238
    99      LG     .25     .25    3.95     .58      31
   100      UI      40     161     238     384     397     267     176      80      48      22
   101      UI      12      12      0.      0.      0.      0.      0.      0.      0.      0.
   102      UI      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
            *

   103      KK     W35
   104      KM    THE FOLLOWING PARAMETERS WERE PROVIDED FOR THIS BASIN
   105      KM    L=    0.860  Lca=      .32   S=   49.2  Kn= .054  LAG=    23
   106      KM    PHOENIX VALLEY S-GRAPH WAS USED FOR THIS BASIN
   107      BA    .089
   108      LG     .25     .25    3.95     .57      25
   109      UI      13      50      75     108     155     108      76      50      22      14
   110      UI      7.      4.      4.      0.      0.      0.      0.      0.      0.      0.
   111      UI      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
```

```
                 *
 112             KK   CP35R
 113             KM        ADD HYDROGRAPHS AT SRW35
 114             HC       2
                 *
 115             KK   SRW35
 116             KM        RET BASIN AT CP30 - 54' WEIR OUTFALL
 117             ZW   A=WT B=SRW35 C=FLOW
 118             RS       1    STOR       0       0
 119             SV       0    3.67    7.67   12.21   17.26   19.89   22.59   25.36   28.21
 120             SE    1153    1154    1155    1156    1157  1157.5    1158  1158.5    1159
 121             SQ     0.1    0.11    0.12    0.13    0.14    0.15    0.15   50.21  142.02
                 *
1                                          HEC-1 INPUT                                          PAGE  4

LINE             ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 122             KK   CPW35
 123             KM        ADD HYDROGRAPHS AT JACKRABBIT TRAIL AND INDIAN SCHOOL RD
 124             ZW   A=WT B=CPW35 C=FLOW
 125             HC       2
                 *
 126             KK  W35W36   ROUTE
 127             KM   PROPOSED JACKRABBIT CHANNEL, BOTTOM WIDTH=40FT, SIDE SLOPE 4:1
 128             ZW   A=WT B=W35W36 C=FLOW
 129             RS       7    FLOW      -1
 130             RC   0.045   0.035   0.045    6051  0.0010
 131             RX     100     110     116     140     180     204     220     230
 132             RY    1001    1000    1000     994     994    1000    1000    1001
                 *
 133             KK     W36   BASIN
 134             BA   0.720
 135             LG    0.30    0.25    4.00    0.55      15
 136             UI       0      75     166     331     432     543     773     886     660     517
 137             UI     403     292     150     125      75      48      23      23      23      23
 138             UI       0       0       0       0       0       0       0       0       0       0
 139             UI       0       0       0       0       0       0       0       0       0       0
 140             UI       0       0       0       0       0       0       0       0       0       0
                 *
 141             KK  DW36RE  DIVERT
 142             KM   ARROYO SECO FUTURE DEVELOPMENT HOLDS 127AC VACANT LAND IN BASIN W36. ASSUME 8
 143             KM   100-YEAR 2-HOUR RETENTION. (C=0.65)(P=2.3IN). PASSQUALITY MOUNTAIN RANCH
 144             KM   PROVIDES A DETENTION BASIN OF NEGLIGIBLE SIZE AND NO RETENTION.
 145             ZW   A=WT B=DW36RE C=FLOW
 146             DT    RW36    12.7
 147             DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
 148             DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
                 *
 149             KK   CPW36 COMBINE
 150             ZW   A=WT B=CPW36 C=FLOW
 151             HC       2   2.911
                 *
 152             KK  W36W37   ROUTE
 153             KM   PROPOSED JACKRABBIT CHANNEL, BOTTOM WIDTH=30FT, SIDE SLOPE 4:1
 154             ZW   A=WT B=W36W37 C=FLOW
 155             RS       5    FLOW      -1
 156             RC   0.045   0.035   0.045    4527  0.0010
 157             RX     100     110     122     150     178     210     220     230
 158             RY    1001    1000    1000     993     993    1000    1000    1001
                 *
1                                          HEC-1 INPUT                                          PAGE  5

LINE             ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 159             KK    W37A
 160             KM    LG VARIABLE VALUES FROM HDR MODEL.
 161             KM    THE FOLLOWING PARAMETERS WERE PROVIDED FOR THIS BASIN
 162             KM    L=      1.9  Lca=      1.0   S=   60.1  Kn= .034  LAG=  28.5
 163             KM    PHOENIX VALLEY S-GRAPH WAS USED FOR THIS BASIN
 164             BA     .63
 165             LG     .29     .25    4.30     .48   19.00
 166             UI     74.    203.    370.    478.    657.    903.    674.    517.    388.    244.
 167             UI    128.     96.     62.     23.     23.     23.     23.      0.      0.      0.
 168             UI      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
                 *
 169             KK  DW37AR  DIVERT
 170             KM   ARROYO SECO FUTURE DEVELOPMENT HOLDS 162AC VACANT LAND IN BASIN W37A. ASSUME
 171             KM   80% 100-YEAR 2-HOUR RETENTION. (C=0.65)(P=2.3IN). THE SOUTH SUBDIVIION IN
 172             KM   BASIN W37A DOES NOT PROVIDE RETENTION.
 173             ZW   A=WT B=DW37AR C=FLOW
 174             DT   RW37A    16.1
 175             DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
 176             DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
                 *
 177             KK  CPW37A COMBINE
 178             ZW   A=WT B=CPW37A C=FLOW
 179             HC       2   3.541
                 *
 180             KK    W37B
 181             KM    LG VARIABLE VALUES FROM HDR MODEL.
 182             KM    THE FOLLOWING PARAMETERS WERE PROVIDED FOR THIS BASIN
 183             KM    L=      2.0  Lca=      1.0   S=   59.2  Kn= .034  LAG=  28.7
 184             KM    PHOENIX VALLEY S-GRAPH WAS USED FOR THIS BASIN
 185             BA     .67
 186             LG     .29     .25    4.30     .48   19.00
 187             UI     79.    214.    390.    503.    686.    962.    720.    553.    416.    270.
 188             UI    137.    105.     69.     24.     24.     24.     24.      0.      0.      0.
 189             UI      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
                 *
 190             KK  DW37BR  DIVERT
 191             KM   ARROYO SECO FUTURE DEVELOPMENT HOLDS 30AC VACANT LAND IN BASIN W37B. ASSUME
 192             KM   80% 100-YEAR 2-HOUR RETENTION. (C=0.65)(P=2.3IN). THE SOUTH SUBDIVIION IN
 193             KM   BASIN W37B DOES NOT PROVIDE RETENTION.
 194             ZW   A=WT B=DW37BR C=FLOW
 195             DT   RW37B     3.0
 196             DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
 197             DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
                 *
1                                          HEC-1 INPUT                                          PAGE  6

LINE             ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 198             KK  CPW37B COMBINE
 199             ZW   A=WT B=CPW37B C=FLOW
 200             HC       2   4.214
                 *
 201             KK  W37W38   ROUTE
 202             ZW   A=WT B=W37W38 C=FLOW
 203             RS       1    FLOW      -1
 204             RC   0.015   0.015   0.015     833  0.0015    0.00
 205             RX  100.00  105.00  109.00  125.00  135.00  151.00  155.00  160.00
 206             RY  1000.0  999.50  999.00  995.00  995.10  999.00  999.50 1000.00
                 *
 207             KK     W38   BASIN
 208             BA   0.163
 209             LG    0.10    0.25    4.15    0.59      84
 210             UI       0      72     224     403     305     162      58      21      11       0
 211             UI       0       0       0       0       0       0       0       0       0       0
 212             UI       0       0       0       0       0       0       0       0       0       0
 213             UI       0       0       0       0       0       0       0       0       0       0
 214             UI       0       0       0       0       0       0       0       0       0       0
                 *
 215             KK  DW38RE  DIVERT
 216             KM   ASSUME 80% 100-YEAR 2-HOUR RETENTION. (C=0.65)(P=2.3IN).
 217             ZW   A=WT B=DW38RE C=FLOW
 218             DT    W38R    10.4     0.0
 219             DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
 220             DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
                 *
 221             KK   CPW38 COMBINE
 222             ZW   A=WT B=CPW38 C=FLOW
 223             HC       2   4.377
                 *
 224             ZZ
1
                 SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
 LINE            (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.            (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

  38               WT3
                    V
                    V
  43            21A28A
                    .
                    .
  50                .        W28A
                    .          .
                    .          .
  62                .          .-------->   RW28A
  58                .      DW28AR
                    .          .
                    .          .
  65            CPW28A...........
                    V
                    V
  68            W28A33
                    .
                    .
  75                .         W33
                    .          .
```

```
                .          .
 84       CPW33...........
                V
                V
 87      W33W35
                .
                .
 94             .        W34
                .          .
                .          .
103             .          .        W35
                .          .          .
                .          .          .
112             .      CP35R...........
                .          V
                .          V
115             .      SRW35
                .          .
                .          .
122      CPW35...........
                V
                V
126     W35W36
                .
                .
133             .        W36
                .          .
                .          .
146             .          .-------->   RW36
141             .     DW36RE
                .          .
                .          .
149      CPW36...........
                V
                V
152     W36W37
                .
                .
159             .        W37A
                .          .
                .          .
174             .          .-------->   RW37A
169             .     DW37AR
                .          .
                .          .
177     CPW37A...........
                .
                .
180             .        W37B
                .          .
                .          .
195             .          .-------->   RW37B
190             .     DW37BR
                .          .
                .          .
198     CPW37B...........
                V
                V
201     W37W38
                .
                .
207             .        W38
                .          .
                .          .
218             .          .-------->   W38R
215             .     DW38RE
                .          .
                .          .
221      CPW38...........
```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	WT3	195.	20.08	194.	191.	135.	21.52		
+	ROUTED TO	21A28A	195.	20.42	194.	191.	135.	21.52		
+	HYDROGRAPH AT	W28A	748.	12.33	86.	25.	8.	.64		
+	DIVERSION TO	RW28A	748.	12.33	56.	15.	5.	.64		
+	HYDROGRAPH AT	DW28AR	576.	12.50	36.	10.	3.	.64		
+	2 COMBINED AT	CPW28A	575.	12.50	201.	194.	138.	.84		
+	ROUTED TO	W28A33	228.	13.00	201.	194.	138.	.84		
+	HYDROGRAPH AT	W33	799.	12.42	93.	27.	9.	.84		
+	2 COMBINED AT	CPW33	795.	12.42	248.	208.	145.	1.68		
+	ROUTED TO	W33W35	701.	12.58	246.	208.	145.	1.68		
+	HYDROGRAPH AT	W34	301.	12.17	33.	10.	3.	.24		
+	HYDROGRAPH AT	W35	106.	12.25	12.	4.	1.	.09		
+	2 COMBINED AT	CP35R	406.	12.25	45.	14.	5.	.33		
+	ROUTED TO	SRW35	10.	13.92	7.	2.	1.	.33		
+	2 COMBINED AT	CPW35	701.	12.58	252.	210.	146.	2.01		
+	ROUTED TO	W35W36	577.	13.08	245.	208.	146.	2.01		
+	HYDROGRAPH AT	W36	640.	12.50	80.	23.	8.	.72		
+	DIVERSION TO	RW36	330.	12.25	23.	6.	2.	.72		
+	HYDROGRAPH AT	DW36RE	640.	12.50	63.	17.	6.	.72		
+	2 COMBINED AT	CPW36	664.	13.08	290.	221.	151.	2.91		
+	ROUTED TO	W36W37	613.	13.33	283.	219.	151.	2.91		
+	HYDROGRAPH AT	W37A	650.	12.33	78.	23.	8.	.63		
+	DIVERSION TO	RW37A	471.	12.17	29.	8.	3.	.63		
+	HYDROGRAPH AT	DW37AR	650.	12.33	55.	15.	5.	.63		
+	2 COMBINED AT	CPW37A	648.	12.33	321.	231.	156.	3.54		
+	HYDROGRAPH AT	W37B	690.	12.33	83.	24.	8.	.67		
+	DIVERSION TO	RW37B	6.	8.42	5.	2.	1.	.67		
+	HYDROGRAPH AT	DW37BR	690.	12.33	83.	23.	8.	.67		
+	2 COMBINED AT	CPW37B	1328.	12.33	387.	249.	163.	4.21		
+	ROUTED TO	W37W38	1355.	12.33	387.	248.	163.	4.21		
+	HYDROGRAPH AT	W38	320.	12.17	39.	14.	5.	.16		
+	DIVERSION TO	W38R	181.	12.00	17.	5.	2.	.16		
+	HYDROGRAPH AT	DW38RE	320.	12.17	29.	8.	3.	.16		
+	2 COMBINED AT	CPW38	1549.	12.33	415.	256.	165.	4.38		

*** NORMAL END OF HEC-1 ***

A.4 EXISTING CONDITIONS WITH PROJECT IN PLACE, 10-YEAR FOR JACKRABBIT CORRIDOR

```
1*****************************************           ***************************************
 *                                       *           *                                     *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *           *   U.S. ARMY CORPS OF ENGINEERS      *
 *              JUN   1998               *           *   HYDROLOGIC ENGINEERING CENTER     *
 *           VERSION 4.1                 *           *        609 SECOND STREET            *
 *                                       *           *     DAVIS, CALIFORNIA 95616         *
 *  RUN DATE    03APR10  TIME  13:03:23  *           *         (916) 756-1104              *
 *                                       *           *                                     *
 *****************************************           ***************************************


                    X     X  XXXXXXX   XXXXX         X
                    X     X  X        X     X       XX
                    X     X  X        X              X
                    XXXXXXX  XXXX     X      XXXXX   X
                    X     X  X        X              X
                    X     X  X        X     X        X
                    X     X  XXXXXXX   XXXXX        XXX


THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM


1                                    HEC-1 INPUT                                          PAGE  1

 LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

    1          ID           WHITE TANKS AREA, WATERSHED CONTRIBUTING TO FRS#3
    2          ID           10-YEAR 24 HOUR STORM
    3          ID           PREPARED BY HOSKIN RYAN CONSULTANTS EXCLUSIVELY FOR
    4          ID           FRS#3 OUTLET CHANNEL DESIGN, 04-01-2010
    5          ID           BASED ON HDR LOOP303/WHITE TANKS ADMPU AHA (09-04-09)
    6          ID           HEC-1 MODEL OF EXISTING CONDITIONS WITH CIP
    7          ID           MODIFICATIONS INCLUDE:
    8          ID           (1) UPDATE WITH AVERAGE RAINFALL DEPTH FOR JACKRABBIT CORRIDOR
    9          ID           (2) UPDATE THE PROPOSED CHANNEL DESIGN
   10          ID           (3) DELETE RETENTION OF PASQUELETTI TO REFLECT EXIST CONDITIONS
   11          ID           (4) DELETE BASIN W21A DUE TO THE ADOPTION OF PIPE AT REACH 9
   12          ID           *******************************************************
   13          ID       Flood Control District of Maricopa County
   14          ID       L303_EX_CIP_MB02 - Loop 303/ White Tanks ADMPU AHA
   15          ID       100 YEAR
   16          ID       24 Hour Storm
   17          ID       Unit Hydrograph: S-Graph
   18          ID       08/18/2009
   19          ID           FCDMC CONTRACT 2007C031
   20          ID           BY HDR ENGINEERING (#79902)
   21          ID           EXISTING CONDITIONS WITH CIP-AUGUST 2009
   22          ID           MAJOR BASIN 02
   23          ID           FILE NAME: ECIP-MB2.DAT
   24          IT       5  1JAN99     1200     2000
   25          IN      15
   26          IO       5
               *DIAGRAM
               *
   27          JD   2.353  0.0001
   28          PC   0.000   0.002   0.005   0.008   0.011   0.014   0.017   0.020   0.023   0.026
   29          PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056   0.060
   30          PC   0.064   0.068   0.072   0.076   0.080   0.085   0.090   0.095   0.100   0.105
   31          PC   0.110   0.115   0.120   0.126   0.133   0.140   0.147   0.155   0.163   0.172
   32          PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
   33          PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
   34          PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
   35          PC   0.913   0.918   0.922   0.926   0.930   0.934   0.938   0.942   0.946   0.950
   36          PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977   0.980
   37          PC   0.983   0.986   0.989   0.992   0.995   0.998   1.000
   38          JD   2.235    10.0
               *

   39          KK     WT3
   40          KM   OUTFLOW FROM WT FRS#3 OUTLET
   41          BA   21.52
   42          KO       5
   43          ZR  =QI A=WT B=FRS3 C=FLOW
               *

   44          KK  21A28A   ROUTE
   45          KM   PROPOSED JACKRABBIT CHANNEL, BOTTOM WIDTH=30FT, SIDE SLOPE 6:1
   46          ZW   A=CIP B=21A28A C=FLOW
   47          RS       4    FLOW      -1
```

```
   48          RC   0.045   0.035   0.045    3560  0.0010
   49          RX     100     110     120     150     180     210     220     230
1                                    HEC-1 INPUT                                          PAGE  2

 LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

   50          RY    1001    1000    1000     995     995    1000    1000    1001
               *

   51          KK    W28ABASIN
   52          KM        Boundary based on Preliminary Design Plans for
   53          KM        White Tanks FRS #3 Outfall Channel dated
   54          KM        12-08-2008 prepared by Gannett Fleming
   55          BA   0.642
   56          LG    0.34    0.32    4.55    0.35       1
   57          UI       0      65     127     296     444     573     621     609     524     407
   58          UI     308     239     181     135     110      80      64      45      44      16
   59          UI      17      16      16      16      16       0       0       0       0       0
   60          UI       0       0       0       0       0       0       0       0       0       0
   61          UI       0       0       0       0       0       0       0       0       0       0
               *

   62          KK  CPW28ACOMBINE
   63          ZW   A=CIP B=CPW28A C=FLOW
   64          HC       2   0.841
               *

   65          KK  W28A33   ROUTE
   66          KM   PROPOSED JACKRABBIT CHANNEL, BOTTOM WIDTH=40FT, SIDE SLOPE 4:1
   67          ZW   A=CIP B=W28A33 C=FLOW
   68          RS       5    FLOW      -1
   69          RC   0.045   0.035   0.045    4336  0.0010
   70          RX     100     110     120     140     180     200     210     220
   71          RY    1001    1000    1000     995     995    1000    1000    1001
               *

   72          KK     W33BASIN
   73          KM        BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
   74          KM        WOOD/PATEL (2006) MODIFIED SLIGHTLY TO MATCH 1990 2' CI TOPO
   75          ZW   A=CIP B=W33 C=FLOW
   76          BA   0.839
   77          LG    0.31    0.27    4.00    0.47       4
   78          UI       0      92     207     460     670     834     886     810     641     473
   79          UI     361     275     195     155     114      85      63      52      23      22
   80          UI      23      22      23       0       0       0       0       0       0       0
   81          UI       0       0       0       0       0       0       0       0       0       0
   82          UI       0       0       0       0       0       0       0       0       0       0
               *

   83          KK   CPW33COMBINE
   84          ZW   A=CIP B=CPW33 C=FLOW
   85          HC       2    1.68
               *

   86          KK  W33W35   ROUTE
   87          KM   PROPOSED JACKRABBIT CHANNEL, BOTTOM WIDTH=40FT, SIDE SLOPE 6:1
   88          ZW   A=CIP B=W33W35 C=FLOW
   89          RS       3    FLOW      -1
   90          RC   0.045   0.035   0.045    2658  0.0010
   91          RX     100     110     116     152     192     228     240     250
   92          RY    1001    1000    1000     994     994    1000    1000    1001
               *
1                                    HEC-1 INPUT                                          PAGE  3

 LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

   93          KK     W35BASIN
   94          KM        BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
   95          KM        WOOD/PATEL (2006) MODIFIED SLIGHTLY TO MATCH 1990 2' CI TOPO
   96          BA   0.283
   97          LG    0.32    0.34    3.71    0.47       4
   98          UI       0      33      83     180     257     312     308     268     201     146
   99          UI     108      80      58      43      33      22      19       8       8       8
  100          UI       8       8       0       0       0       0       0       0       0       0
  101          UI       0       0       0       0       0       0       0       0       0       0
  102          UI       0       0       0       0       0       0       0       0       0       0
               *

  103          KK     W34BASIN
  104          KM        BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
  105          KM        WOOD/PATEL (2006) MODIFIED SLIGHTLY TO MATCH 1990 2' CI TOPO
  106          BA   0.228
  107          LG    0.32    0.31    3.74    0.46      20
  108          UI       0      33     131     238     312     316     236     162     111      74
  109          UI      52      34      23      13       9       8       9       0       0       0
  110          UI       0       0       0       0       0       0       0       0       0       0
  111          UI       0       0       0       0       0       0       0       0       0       0
  112          UI       0       0       0       0       0       0       0       0       0       0
               *

  113          KK   SRW34STORAGE
  114          KM        Master Drainage Plan for the Caterpillar Property (Basin #29)
  115          KO
  116          RS       1    STOR
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```
 117          SV            0.99   12.73   23.45   36.25   50.68   54.76   59.33   83.20
 118          SQ                                                           88.00 6226.00
 119          SE  1164.5 1166.00 1170.00 1172.00 1174.00 1176.00 1177.50 1178.00 1180.00
 120          ST
              *

 121          KK  W34W35ROUTE
 122          KM        Cross-section: Estimated 3' deep and 4:1 side slopes, width based on
 123          KM        aerial. Manning's N Value: clean straight earth
 124          RS       1    FLOW
 125          RC   0.022   0.022   0.022     813  0.0111    0.00
 126          RX  100.00  104.00  108.00  120.00  132.00  144.00  152.00  160.00
 127          RY  1166.2 1166.10 1166.00 1160.00 1160.10 1162.00 1162.10 1162.20
              *

 128          KK   CPW35COMBINE
 129          ZW   A=CIP B=CPW35 C=FLOW
 130          HC       3   2.191
              *

 131          KK  W35W36   ROUTE
 132          KM   PROPOSED JACKRABBIT CHANNEL, BOTTOM WIDTH=40FT, SIDE SLOPE 4:1
 133          ZW   A=CIP B=W35W36 C=FLOW
 134          RS       7    FLOW      -1
 135          RC   0.045   0.035   0.045    6051  0.0010
 136          RX     100     110     116     140     180     204     220     230
1                                        HEC-1 INPUT                                         PAGE  4

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 137          RY    1001    1000    1000     994     994    1000    1000    1001
              *

 138          KK     W36BASIN
 139          KM        Boundary based on Aerial, topo, and Preliminary
 140          KM        Design Plans for White Tanks FRS #3 Outfall Channel
 141          KM        dated 12-08-2008 prepared by Gannett Fleming
 142          BA   0.720
 143          LG    0.31    0.28    4.00    0.47       4
 144          UI       0      65     101     247     385     507     591     617     609     513
 145          UI     409     329     255     204     160     126     102      76      64      45
 146          UI      45      25      16      16      15      16      16      16       0       0
 147          UI       0       0       0       0       0       0       0       0       0       0
 148          UI       0       0       0       0       0       0       0       0       0       0
              *

 149          KK   CPW36COMBINE
 150          ZW   A=CIP B=CPW36 C=FLOW
 151          HC       2   2.911
              *

 152          KK  W36W37   ROUTE
 153          KM   PROPOSED JACKRABBIT CHANNEL, BOTTOM WIDTH=30FT, SIDE SLOPE 4:1
 154          ZW   A=CIP B=W36W37 C=FLOW
 155          RS       5    FLOW      -1
 156          RC   0.045   0.035   0.045    4527  0.0010
 157          RX     100     110     122     150     178     210     220     230
 158          RY    1001    1000    1000     993     993    1000    1000    1001
              *

 159          KK     W37BASIN
 160          KM        WESTERN LIMIT DEFINED BY JACKRABBIT WASH
 161          KM        CAPACITY APPROX 12,000 CFS, VALENCIA HEIGHTS
 162          BA   1.210
 163          LG    0.32    0.31    4.20    0.44       4
 164          UI       0      96     112     318     497     664     822     897     937     893
 165          UI     777     643     515     421     344     278     221     186     148     115
 166          UI     104      69      66      63      23      24      23      24      23      24
 167          UI      24       0       0       0       0       0       0       0       0       0
 168          UI       0       0       0       0       0       0       0       0       0       0
              *

 169          KK     W22BASIN
 170          KM        BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
 171          KM        WOOD/PATEL (2006) MODIFIED SLIGHTLY TO MATCH 1990 2' CI TOPO
 172          BA   0.782
 173          LG    0.35    0.35    4.15    0.44      19
 174          UI       0     237     914    1559    1035     751     503     352     228     158
 175          UI     107      80      37      31      31      31       0       0       0       0
 176          UI       0       0       0       0       0       0       0       0       0       0
 177          UI       0       0       0       0       0       0       0       0       0       0
 178          UI       0       0       0       0       0       0       0       0       0       0
              *
1                                        HEC-1 INPUT                                         PAGE  5

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 179          KK  W22W23ROUTE
 180          KM        Cross-section: Based on aerial and topo
 181          KM        Manning's N Value: pavement and natural desert wash w/ vegetation
 182          RS       1    FLOW
 183          RC   0.035   0.013   0.035    4866  0.0719    0.00
 184          RX  100.00  112.00  113.00  126.00  439.00  477.00  496.00  515.00
 185          RY  1820.0 1815.00 1810.00 1800.00 1799.90 1810.00 1815.00 1820.00
              *

 186          KK     W23BASIN
 187          KM        BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
 188          KM        WOOD/PATEL (2006) MODIFIED SLIGHTLY TO MATCH 1990 2' CI TOPO
 189          BA   0.897
 190          LG    0.35    0.35    4.35    0.40      18
 191          UI       0     236     906    1581    1306     885     636     424     309     204
 192          UI     145      98      80      33      34      33      33       0       0       0
 193          UI       0       0       0       0       0       0       0       0       0       0
 194          UI       0       0       0       0       0       0       0       0       0       0
 195          UI       0       0       0       0       0       0       0       0       0       0
              *

 196          KK   CPW23COMBINE
 197          HC       2   1.679
              *

 198          KK  W23W24ROUTE
 199          KM        Cross-section: Based on aerial and topo
 200          KM        Manning's N Value: natural desert wash w/ vegetation
 201          RS       1    FLOW
 202          RC   0.045   0.035   0.045    5335  0.0367    0.00
 203          RX  100.00  120.00  140.00  180.00  220.00  240.00  260.00  280.00
 204          RY  1462.0 1461.00 1460.00 1450.00 1450.10 1460.00 1461.00 1462.00
              *

 205          KK     W24BASIN
 206          KM        BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
 207          KM        WOOD/PATEL (2006) MODIFIED SLIGHTLY TO MATCH 1990 2' CI TOPO
 208          BA   0.475
 209          LG    0.35    0.35    4.90    0.29      14
 210          UI       0      88     342     575     788     483     372     280     201     154
 211          UI     104      82      60      39      38      15      14      15      15       0
 212          UI       0       0       0       0       0       0       0       0       0       0
 213          UI       0       0       0       0       0       0       0       0       0       0
 214          UI       0       0       0       0       0       0       0       0       0       0
              *

 215          KK   CPW24COMBINE
 216          HC       2   2.154
              *
1                                        HEC-1 INPUT                                         PAGE  6

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 217          KK  W24W27ROUTE
 218          KM        Cross-section: Based on aerial and topo
 219          KM        Manning's N Value: natural desert wash w/ vegetation
 220          RS       1    FLOW
 221          RC   0.035   0.035   0.035    5873  0.0289    0.00
 222          RX  100.00  120.00  140.00  160.00  180.00  200.00  220.00  240.00
 223          RY  1094.0 1092.00 1090.00 1084.00 1084.10 1090.00 1090.25 1090.50
              *

 224          KK     W25BASIN
 225          KM        BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
 226          KM        WOOD/PATEL (2006) MODIFIED SLIGHTLY TO MATCH 1990 2' CI TOPO
 227          BA   1.099
 228          LG    0.35    0.35    4.80    0.30       8
 229          UI       0     143     438     866    1174    1490     915     737     620     467
 230          UI     358     307     216     171     140     110      76      71      53      27
 231          UI      28      28      27      28       0       0       0       0       0       0
 232          UI       0       0       0       0       0       0       0       0       0       0
 233          UI       0       0       0       0       0       0       0       0       0       0
              *

 234          KK   SRW25STORAGE
 235          KM        Verrado on-line storage basin (WoodPatel ID SR20)
 236          KO
 237          RS       1    STOR
 238          SV            1.05    9.43   26.91   54.31   92.89  138.67  176.47  190.08  219.05
 239          SQ                                                                   265.00 1377.00
 240          SE  1443.0 1446.00 1450.00 1454.00 1458.00 1462.00 1466.00 1469.00 1470.00 1472.00
 241          ST
              *

 242          KK  W25W26ROUTE
 243          KM        Cross-section: Based on aerial and topo
 244          KM        Manning's N Value: natural desert wash w/ vegetation
 245          RS       1    FLOW
 246          RC   0.035   0.035   0.035    6978  0.0178    0.00
 247          RX  100.00  120.00  140.00  156.00  176.00  192.00  212.00  232.00
 248          RY  1451.5 1451.25 1451.00 1447.00 1447.10 1451.00 1451.25 1451.50
              *

 249          KK     W26BASIN
 250          KM        BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
 251          KM        WOOD/PATEL (2006) MODIFIED SLIGHTLY TO MATCH 1990 2' CI TOPO
 252          BA   0.682
 253          LG    0.33    0.37    6.20    0.17      15
 254          UI       0      86     245     500     680     926     574     465     390     304
 255          UI     231     197     152     110      95      69      59      43      42      21
 256          UI      17      16      17      16      17       0       0       0       0       0
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 257        UI      0      0      0      0      0      0      0      0      0      0
 258        UI      0      0      0      0      0      0      0      0      0      0
            *
1                                   HEC-1 INPUT                                          PAGE  7

LINE        ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 259        KK  CPW26COMBINE
 260        HC      2   1.781
            *

 261        KK  SRW26STORAGE
 262        KM       Verrado on-line storage basin (WoodPatel ID SR21 and PH 6 Golf)
 263        KO
 264        RS      1    STOR
 265        SV            0.68   20.68   57.58   95.91  102.34  117.65  130.00
 266        SQ                                          265.00 1377.00 2000.00
 267        SE  1319.0 1320.00 1330.00 1340.00 1347.00 1348.00 1350.00 1351.00
 268        ST
            *

 269        KK  W26W27ROUTE
 270        KM       Cross-section: based on topo and aerial
 271        KM       Manning's N Value: natural desert wash w/ vegetation
 272        RS      1    FLOW
 273        RC   0.035   0.035   0.035    3484  0.0172    0.00
 274        RX  100.00  120.00  140.00  152.00  168.00  180.00  200.00  220.00
 275        RY  1298.5 1298.25 1298.00 1294.00 1294.10 1298.00 1298.25 1298.50
            *

 276        KK    W27BASIN
 277        KM       BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
 278        KM       WOOD/PATEL (2006) MODIFIED SLIGHTLY TO MATCH 1990 2' CI TOPO
 279        BA   0.411
 280        LG    0.32    0.37    5.80    0.20      11
 281        UI       0      76     296     498     681     418     323     241     174     133
 282        UI      91      71      51      34      33      13      13      13      13       0
 283        UI       0       0       0       0       0       0       0       0       0       0
 284        UI       0       0       0       0       0       0       0       0       0       0
 285        UI       0       0       0       0       0       0       0       0       0       0
            *

 286        KK  CPW27COMBINE
 287        HC      3   4.345
            *

 288        KK  W27W44ROUTE
 289        KM       Cross-section: Clean straight earth
 290        RS      1    FLOW
 291        RC   0.022   0.022   0.022    7169  0.0098    0.00
 292        RX  100.00  182.00  270.00  288.00  318.00  329.00  333.00  338.00
 293        RY  1256.0 1254.00 1250.00 1248.00 1248.00 1250.00 1254.00 1256.00
            *

 294        KK    W43BASIN
 295        KM       BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
 296        KM       WOOD/PATEL (2006) MODIFIED SLIGHTLY TO MATCH 1990 2' CI TOPO
 297        BA   0.209
 298        LG    0.20    0.28    3.48    0.55      61
 299        UI       0     971     508     111       0       0       0       0       0       0
 300        UI       0       0       0       0       0       0       0       0       0       0
1                                   HEC-1 INPUT                                          PAGE  8

LINE        ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 301        UI       0       0       0       0       0       0       0       0       0       0
 302        UI       0       0       0       0       0       0       0       0       0       0
 303        UI       0       0       0       0       0       0       0       0       0       0
            *

 304        KK  SRW43STORAGE
 305        KM       Verrado on-line storage basin (WLB) (WoodPatel ID SR23)
 306        KO
 307        RS      1    STOR
 308        SV            6.04   20.38   53.82  120.38  216.24  325.98  455.42  606.10  645.49
 309        SQ
 310        SE  1272.0 1276.00 1280.00 1284.00 1288.00 1292.00 1296.00 1300.00 1304.00 1305.00
 311        ST
            *

 312        KK  W43W44ROUTE
 313        KM       Cross-section: Side slopes and width based on aerial and topo
 314        KM       Manning's N Value: natural desert wash w/ vegetation
 315        RS      1    FLOW
 316        RC   0.035   0.035   0.035    8415  0.0125    0.00
 317        RX  100.00  145.00  180.00  210.00  220.00  245.00  270.00  295.00
 318        RY  1266.0 1264.00 1262.00 1258.00 1258.00 1262.00 1265.50 1266.00
            *

 319        KK    W44BASIN
 320        KM       BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
 321        KM       WOOD/PATEL (2006) MODIFIED SLIGHTLY TO MATCH 1990 2' CI TOPO
 322        BA   0.598
 323        LG    0.35    0.35    4.90    0.29       0
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 324        UI       0      55      89     214     334     438     500     527     506     421
 325        UI     332     266     206     162     127      99      82      59      48      37
 326        UI      37      13      14      13      14      13      14       0       0       0
 327        UI       0       0       0       0       0       0       0       0       0       0
 328        UI       0       0       0       0       0       0       0       0       0       0
            *

 329        KK  CPW44COMBINE
 330        HC      3   5.153
            *

 331        KK  W44W46ROUTE
 332        KM       Cross-section: Estimated 2' deep, side slopes and width based on aerial
 333        KM       and topo. Manning's N Value: earth w/ sparse trees and shrubs
 334        RS      1    FLOW
 335        RC   0.032   0.032   0.032    1706  0.0070    0.00
 336        RX  100.00  116.00  132.00  162.00  192.00  252.00  272.00  292.00
 337        RY  1216.0 1215.00 1214.00 1208.00 1208.10 1210.00 1211.00 1212.00
            *

 338        KK    W45BASIN
 339        KM       BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
 340        KM       WOOD/PATEL (2006) MODIFIED SLIGHTLY TO MATCH 1990 2' CI TOPO
 341        BA   1.035
 342        LG    0.35    0.33    7.30    0.11       3
 343        UI       0     136     414     824    1120    1399     860     697     573     441
1                                   HEC-1 INPUT                                          PAGE  9

LINE        ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 344        UI     336     286     202     161     130     104      71      67      47      26
 345        UI      26      26      26      26       0       0       0       0       0       0
 346        UI       0       0       0       0       0       0       0       0       0       0
 347        UI       0       0       0       0       0       0       0       0       0       0
            *

 348        KK  W45W46ROUTE
 349        KM       Cross-section: Based on aerial and topo
 350        KM       Manning's N Value: natural desert wash w/ vegetation
 351        RS      4    FLOW
 352        RC   0.035   0.035   0.035    9372  0.0125    0.00
 353        RX  100.00  160.00  205.00  265.00  285.00  310.00  345.00  385.00
 354        RY  1274.0 1270.00 1268.00 1262.00 1262.10 1272.00 1275.50 1276.00
            *

 355        KK    W46BASIN
 356        KM       BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
 357        KM       WOOD/PATEL (2006) MODIFIED SLIGHTLY TO MATCH 1990 2' CI TOPO
 358        BA   0.926
 359        LG    0.27    0.29    6.40    0.18      16
 360        UI       0      88     165     367     477     592     749    1082     916     727
 361        UI     580     459     331     180     148      97      75      27      27      27
 362        UI      28      27       0       0       0       0       0       0       0       0
 363        UI       0       0       0       0       0       0       0       0       0       0
 364        UI       0       0       0       0       0       0       0       0       0       0
            *

 365        KK  CPW46ACOMBINE
 366        HC      2   1.961
            *

 367        KK  DW46REDIVERT
 368        KM       Master Drainage Plan for the Caterpillar Property (Basin #27)
 369        DT    RW46     0.0     0.0
 370        DI     0.0    35.0    98.0   179.0   276.0   520.0   888.0  1339.0  1859.0  2439.0
 371        DQ     0.0     0.0     0.0     0.0     0.0   135.0   382.0   701.0  1080.0  1509.0
            *

 372        KK  CPW46BCOMBINE
 373        HC      2   7.114
            *

 374        KK  W46W54ROUTE
 375        KM       Cross-section: side slopes, width based on aerial and topo
 376        KM       Manning's N Value: natural desert wash w/ vegetation
 377        RS      1    FLOW
 378        RC   0.035   0.035   0.035    3908  0.0397    0.00
 379        RX  100.00  112.00  124.00  140.00  160.00  190.00  220.00  240.00
 380        RY  1194.5 1194.00 1190.00 1184.00 1184.10 1186.00 1190.00 1190.50
            *
1                                   HEC-1 INPUT                                          PAGE 10

LINE        ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 381        KK    W47BASIN
 382        KM       BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
 383        KM       WOOD/PATEL (2006) MODIFIED SLIGHTLY TO MATCH 1990 2' CI TOPO
 384        BA   0.666
 385        LG    0.35    0.35    3.95    0.40      20
 386        UI       0      96     349     638     936     788     540     432     340     243
 387        UI     202     142     111      83      66      47      43      19      19      18
 388        UI      19      18       0       0       0       0       0       0       0       0
 389        UI       0       0       0       0       0       0       0       0       0       0
 390        UI       0       0       0       0       0       0       0       0       0       0
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391              KK     W48BASIN
392              KM        BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
393              KM        WOOD/PATEL (2006) MODIFIED SLIGHTLY TO MATCH 1990 2' CI TOPO
394              BA   0.353
395              LG    0.35    0.35    3.95    0.40      20
396              UI       0      57     232     395     573     367     281     216     157     124
397              UI      85      65      48      36      28      20      10      11      11      11
398              UI       0       0       0       0       0       0       0       0       0       0
399              UI       0       0       0       0       0       0       0       0       0       0
400              UI       0       0       0       0       0       0       0       0       0       0
                 *

401              KK   CPW47COMBINE
402              HC       2   1.019
                 *

403              KK  W47W49ROUTE
404              KM        Cross-section: Based on aerial and topo
405              KM        Manning's N Value: natural desert wash w/ vegetation
406              RS       1    FLOW
407              RC   0.035   0.035   0.035    5077  0.0414    0.00
408              RX  100.00  150.00  190.00  210.00  235.00  255.00  275.00  310.00
409              RY  1740.0 1720.00 1710.00 1707.00 1708.00 1714.00 1730.00 1740.00
                 *

410              KK     W50BASIN
411              KM        BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
412              KM        WOOD/PATEL (2006) MODIFIED SLIGHTLY TO MATCH 1990 2' CI TOPO
413              BA   1.345
414              LG    0.35    0.35    4.25    0.42      19
415              UI       0     122     193     458     725     898    1129    1321     842     706
416              UI     619     546     461     378     312     278     240     189     156     135
417              UI     120      93      88      60      60      59      35      24      23      24
418              UI      23      24      24      23      23       0       0       0       0       0
419              UI       0       0       0       0       0       0       0       0       0       0
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1 HEC-1 INPUT PAGE 11

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LINE             ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

420              KK     W49BASIN
421              KM        BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
422              KM        WOOD/PATEL (2006) MODIFIED SLIGHTLY TO MATCH 1990 2' CI TOPO
423              BA   0.385
424              LG    0.35    0.35    3.95    0.40      20
425              UI       0      67     265     450     633     398     302     232     166     129
426              UI      89      70      48      35      31      16      12      12      12      11
427              UI       0       0       0       0       0       0       0       0       0       0
428              UI       0       0       0       0       0       0       0       0       0       0
429              UI       0       0       0       0       0       0       0       0       0       0
                 *

430              KK   CPW49COMBINE
431              HC       3   2.749
                 *

432              KK  W49W51ROUTE
433              KM        Cross-section: side slopes, width based on aerial and topo
434              KM        Manning's N Value: natural desert wash w/ vegetation
435              RS       1    FLOW
436              RC   0.035   0.035   0.035    5726  0.0253    0.00
437              RX  100.00  150.00  220.00  236.00  286.00  300.00  340.00  380.00
438              RY  1485.0 1482.00 1479.00 1476.00 1476.10 1479.00 1485.00 1490.00
                 *

439              KK     W51BASIN
440              KM        BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
441              KM        WOOD/PATEL (2006) MODIFIED SLIGHTLY TO MATCH 1990 2' CI TOPO
442              BA   0.149
443              LG    0.35    0.35    3.85    0.43       1
444              UI       0      21      74     140     188     200     165     113      79      55
445              UI      38      26      18      14       5       5       5       5       0       0
446              UI       0       0       0       0       0       0       0       0       0       0
447              UI       0       0       0       0       0       0       0       0       0       0
448              UI       0       0       0       0       0       0       0       0       0       0
                 *

449              KK   CPW51COMBINE
450              HC       2   2.898
                 *

451              KK     W52BASIN
452              KM        BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
453              KM        WOOD/PATEL (2006) MODIFIED SLIGHTLY TO MATCH 1990 2' CI TOPO
454              BA   1.123
455              LG    0.35    0.35    4.40    0.38       9
456              UI       0     116     224     522     764     958    1288     824     673     577
457              UI     489     413     317     275     240     179     147     128     100      88
458              UI      67      57      56      35      22      22      22      22      22      22
459              UI      22       0       0       0       0       0       0       0       0       0
460              UI       0       0       0       0       0       0       0       0       0       0
                 *
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1 HEC-1 INPUT PAGE 12

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LINE             ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

461              KK   CPW52COMBINE
462              HC       2   4.021
                 *

463              KK  W52W53ROUTE
464              KM        Cross-section: Estimated 3' deep and 4:1 side slopes, width based on
465              KM        aerial. Manning's N Value: natural desert wash w/ vegetation
466              RS       1    FLOW
467              RC   0.035   0.035   0.035    4917  0.0112    0.00
468              RX  100.00  118.00  124.00  130.00  146.00  150.00  164.00  182.00
469              RY  1375.0 1373.00 1370.00 1368.00 1368.00 1370.00 1373.00 1375.00
                 *

470              KK     W53BASIN
471              KM        BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
472              KM        WOOD/PATEL (2006) MODIFIED SLIGHTLY TO MATCH 1990 2' CI TOPO
473              BA   0.568
474              LG    0.30    0.32    4.45    0.42       7
475              UI       0     223     858    1219     946     528     288     161      89      32
476              UI      31       0       0       0       0       0       0       0       0       0
477              UI       0       0       0       0       0       0       0       0       0       0
478              UI       0       0       0       0       0       0       0       0       0       0
479              UI       0       0       0       0       0       0       0       0       0       0
                 *

480              KK   CPW53COMBINE
481              HC       2   4.589
                 *

482              KK  DW53REDIVERT
483              KM        Verrado - Planning Unti Drainage Plan for Portions of Planning Unit V
484              KM        (2nd Submittal) (ESTIMATED FROM GOLF BASINS IN REPORT)
485              DT    RW53     0.0     0.0
486              DI     0.0  1000.0  1500.0  2000.0  2500.0  3000.0  3500.0  4000.0  4145.0  4500.0
487              DQ     0.0    10.0   115.0   290.0   460.0   715.0   980.0  1100.0  1145.0  1260.0
                 *

488              KK  W53W54ROUTE
489              KM        Cross-section: side slopes, width based on aerial and topo
490              KM        Manning's N Value: natural desert wash w/ vegetation
491              RS       2    FLOW
492              RC   0.035   0.035   0.035    9900  0.0157    0.00
493              RX  100.00  124.00  144.00  150.00  160.00  190.00  220.00  240.00
494              RY  1194.5 1194.00 1190.00 1184.00 1184.10 1186.00 1190.00 1190.50
                 *

495              KK     W54BASIN
496              KM        BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
497              KM        WOOD/PATEL (2006) MODIFIED SLIGHTLY TO MATCH 1990 2' CI TOPO
498              BA   0.980
499              LG    0.23    0.26    4.50    0.43      18
500              UI       0     105     248     485     621     807    1191    1143     882     676
501              UI     520     329     183     143     104      33      32      32      33       0
502              UI       0       0       0       0       0       0       0       0       0       0
```

1 HEC-1 INPUT PAGE 13

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LINE             ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

503              UI       0       0       0       0       0       0       0       0       0       0
504              UI       0       0       0       0       0       0       0       0       0       0
                 *

505              KK   CPW54COMBINE
506              HC       3  12.683
                 *

507              KK  W54W57ROUTE
508              KM        Cross-section: side slopes and width based on aerial
509              KM        Manning's N Value: natural desert wash w/ vegetation
510              RS       1    FLOW
511              RC   0.035   0.035   0.035    5173  0.0151    0.00
512              RX  100.00  124.00  144.00  156.00  180.00  204.00  216.00  228.00
513              RY  1126.0 1125.00 1124.00 1114.00 1114.10 1117.00 1117.50 1118.00
                 *

514              KK     W56BASIN
515              KM        BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
516              KM        WOOD/PATEL (2006) MODIFIED SLIGHTLY TO MATCH 1990 2' CI TOPO
517              BA   0.448
518              LG    0.17    0.28    4.20    0.61       5
519              UI       0     143     474     812     956     583     279     126      47      28
520              UI       0       0       0       0       0       0       0       0       0       0
521              UI       0       0       0       0       0       0       0       0       0       0
522              UI       0       0       0       0       0       0       0       0       0       0
523              UI       0       0       0       0       0       0       0       0       0       0
                 *

524              KK  DW56REDIVERT
525              KM        Sienna Hills (aka Tesota Hills) Preliminary Drainage Report
526              DT    RW56    35.6     0.0
```

```
527          DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
528          DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
             *

529          KK  W56W57ROUTE
530          KM        Cross-section: Estimated 3' deep and 4:1 side slopes, width
531          KM        based on aerial / Manning's N Value: clean straight earth
532          RS       1    FLOW
533          RC   0.022   0.022   0.022    4948  0.0038    0.00
534          RX  100.00  108.00  116.00  128.00  131.00  143.00  153.00  163.00
535          RY  1108.5 1108.25 1108.00 1105.00 1105.10 1108.00 1108.25 1108.50
             *

536          KK     W55BASIN
537          KM        BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
538          KM        WOOD/PATEL (2006) MODIFIED SLIGHTLY TO MATCH 1990 2' CI TOPO
539          BA   0.496
540          LG    0.32    0.33    4.00    0.50      17
541          UI       0      80     326     555     806     516     393     304     221     173
542          UI     120      92      67      51      38      29      15      15      15      15
543          UI       0       0       0       0       0       0       0       0       0       0
544          UI       0       0       0       0       0       0       0       0       0       0
545          UI       0       0       0       0       0       0       0       0       0       0
             *
1                                        HEC-1 INPUT                                          PAGE 14
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

546          KK  DW55REDIVERT
547          KM        Verado GOB5
548          DT   DW55S     0.0     0.0
549          DI     0.0    55.0   101.0   537.0  1297.0  2269.0  4708.0  7684.0 11074.0     0.0
550          DQ     0.0     0.0     0.0   382.0  1080.0  1984.0  4269.0  7072.0 10310.0     0.0
             *

551          KK  W55W57ROUTE
552          KM        Cross-section: Estimated 2' deep and 4:1 side slopes, width
553          KM        based on aerial / Manning's N Value: natural desert wash w/ vegetation
554          RS       4    FLOW
555          RC   0.035   0.035   0.035    5747  0.0096    0.00
556          RX  100.00  110.00  120.00  136.00  156.00  172.00  192.00  212.00
557          RY  1136.5 1136.25 1136.00 1134.00 1134.10 1136.00 1136.25 1136.50
             *

558          KK     W57BASIN
559          KM        BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
560          KM        WOOD/PATEL, 2006 MODIFIED SLIGHTLY TO MATCH NEW TOPO
561          BA   1.161
562          LG    0.27    0.29    4.65    0.37      19
563          UI       0     138     388     695     889    1284    1641    1231     946     700
564          UI     409     239     166     101      43      43      42       0       0       0
565          UI       0       0       0       0       0       0       0       0       0       0
566          UI       0       0       0       0       0       0       0       0       0       0
567          UI       0       0       0       0       0       0       0       0       0       0
             *

568          KK  DW57REDIVERT
569          KM        Master Drainage Plan for the Caterpillar Property (Basin #42)
570          DT    RW57    21.6     0.0
571          DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
572          DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
             *

573          KK   CPW57COMBINE
574          HC       4  14.788
             *

575          KK   SRW57STORAGE
576          KM        Verrado SR42
577          KO
578          RS       1    STOR
579          SV            24.40   29.60   35.70   42.00   48.50   55.20   62.20   69.30   76.70
580          SQ                                   368.00 1040.00 1912.00 2944.00 4114.00 5410.00
581          SE  1084.0 1090.00 1091.00 1092.00 1093.00 1094.00 1095.00 1096.00 1097.00 1098.00
582          ST
             *
1                                        HEC-1 INPUT                                          PAGE 15
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

583          KK  W57W58ROUTE
584          KM        Cross-section: Taken from aerial and topo
585          RS       1    FLOW
586          RC   0.022   0.022   0.022    1236  0.0067    0.00
587          RX  100.00  115.50  121.80  142.00  179.30  191.30  199.60  207.80
588          RY  1072.0 1070.00 1064.00 1062.00 1061.90 1064.00 1065.00 1066.00
             *

589          KK     W58BASIN
590          KM        BASIN BOUNDARY VARIES FROM VERRADO DEVEL.COND.PLAN WOOD/PATEL 2006
591          KM        NEW 2' CI TOPO OBTAINED 2008
592          BA   0.131
593          LG    0.30    0.33    4.65    0.35      18
594          UI       0      25     101     176     208     180     117      75      48      32
595          UI      19      14       5       5       6       0       0       0       0       0
596          UI       0       0       0       0       0       0       0       0       0       0
597          UI       0       0       0       0       0       0       0       0       0       0
598          UI       0       0       0       0       0       0       0       0       0       0
             *

599          KK   CPW58COMBINE
600          HC       2  14.919
             *

601          KK   SRW58STORAGE
602          KM        Storage based on new topo section calculations
603          KO
604          RS       1    STOR
605          SV            0.17    2.57    5.40   13.08   31.52   47.89   64.25  111.96  171.81
606          SQ                  784.10 2217.60 3099.20 3799.80 4122.90 4540.00 6878.8012249.90
607          SE  1084.0 1086.00 1088.00 1090.00 1092.00 1094.00 1095.00 1096.00 1098.00 1100.00
608          ST
             *

609          KK  DW58SEDIVERT
610          KM        Divert is stage storage on 4-10x8 boxes under I-10. Diverted flow goes s
611          DT   DW58S     0.0     0.0
612          DI     0.0   100.0  2000.0  4100.0  4200.0  5000.0  6000.0  7000.0  8000.0  9000.0
613          DQ     0.0   100.0  2000.0  4100.0  4195.5  4606.7  4833.2  4983.7  5102.6  5203.3
             *

614          KK     W38BASIN
615          KM        BASIN BOUNDARY FORMED BY MCDOWELL, I-10, JACKRABBIT
616          KM        AND TUTHILL, DETAILED I-10 TOPO AND CULVERT INFO
617          BA   0.251
618          LG    0.32    0.32    4.65    0.33       7
619          UI       0      30      77     163     235     279     279     236     174     127
620          UI      93      68      51      36      27      20      14       7       7       8
621          UI       7       0       0       0       0       0       0       0       0       0
622          UI       0       0       0       0       0       0       0       0       0       0
623          UI       0       0       0       0       0       0       0       0       0       0
             *
1                                        HEC-1 INPUT                                          PAGE 16
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

624          KK   CPW38COMBINE
625          HC       2   15.17
             *

626          KK  DW38SEDIVERT
627          KM        Full flow capacity of culverts under I-10 is diverted flow
628          DT   DW38S     0.0     0.0
629          DI     0.0   100.0   200.0   300.0   400.0   467.0   500.0   800.0  1000.0 10000.0
630          DQ     0.0   100.0   200.0   300.0   400.0   467.0   467.0   467.0   467.0   467.0
             *

631          KK  W38W37ROUTE
632          KM        Cross section based from 1990 topo, Manning's N Value: clean earth
633          RS       3    FLOW
634          RC   0.022   0.022   0.022    2849  0.0053    0.00
635          RX  100.00  204.00  440.00  608.00  687.00  700.00  736.00  759.00
636          RY  1083.0 1082.00 1080.00 1078.00 1078.00 1080.00 1082.00 1083.00
             *

637          KK   CPW37COMBINE
638          ZW   A=CIP B=CPW37 C=FLOW
639          HC       3  19.291
             *
640          ZZ
1
                 SCHEMATIC DIAGRAM OF STREAM NETWORK
INPUT
 LINE        (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.        (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

   39          WT3
                V
                V
   44       21A28A
                .
                .
   51           .        W28A
                .           .
                .           .
   62       CPW28A............
                V
                V
   65       W28A33
                .
                .
   72           .         W33
                .           .
                .           .
   83        CPW33............
                V
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                V
 86        W33W35
                .
                .
 93             .          W35
                .            .
                .            .
103             .            .        W34
                .            .          V
                .            .          V
113             .            .       SRW34
                .            .          V
                .            .          V
121             .            .     W34W35
                .            .          .
                .            .          .
128        CPW35.......................
                V
                V
131        W35W36
                .
                .
138             .          W36
                .            .
                .            .
149        CPW36............
                V
                V
152        W36W37
                .
                .
159             .          W37
                .            .
                .            .
169             .            .        W22
                .            .          V
                .            .          V
179             .            .     W22W23
                .            .          .
                .            .          .
186             .            .          .        W23
                .            .          .          .
                .            .          .          .
196             .            .     CPW23............
                .            .          V
                .            .          V
198             .            .     W23W24
                .            .          .
                .            .          .
205             .            .          .        W24
                .            .          .          .
                .            .          .          .
215             .            .     CPW24............
                .            .          V
                .            .          V
217             .            .     W24W27
                .            .          .
                .            .          .
224             .            .          .        W25
                .            .          .          V
                .            .          .          V
234             .            .          .       SRW25
                .            .          .          V
                .            .          .          V
242             .            .          .      W25W26
                .            .          .          .
                .            .          .          .
249             .            .          .          .        W26
                .            .          .          .          .
                .            .          .          .          .
259             .            .          .      CPW26............
                .            .          .          V
                .            .          .          V
261             .            .          .       SRW26
                .            .          .          V
                .            .          .          V
269             .            .          .      W26W27
                .            .          .          .
                .            .          .          .
276             .            .          .          .        W27
                .            .          .          .          .
                .            .          .          .          .
286             .            .     CPW27.......................
                .            .          V
                .            .          V
288             .            .     W27W44
                .            .          .
                .            .          .
294             .            .          .        W43
                .            .          .          V
                .            .          .          V
304             .            .          .       SRW43
                .            .          .          V
                .            .          .          V
312             .            .          .      W43W44
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                .            .          .          .
                .            .          .          .
319             .            .          .          .        W44
                .            .          .          .          .
                .            .          .          .          .
329             .            .     CPW44.......................
                .            .          V
                .            .          V
331             .            .     W44W46
                .            .          .
                .            .          .
338             .            .          .        W45
                .            .          .          V
                .            .          .          V
348             .            .          .     W45W46
                .            .          .          .
                .            .          .          .
355             .            .          .          .        W46
                .            .          .          .          .
                .            .          .          .          .
365             .            .          .     CPW46A............
                .            .          .          .
                .            .          .          .
369             .            .          .          .-------->    RW46
367             .            .          .     DW46RE
                .            .          .          .
                .            .          .          .
372             .            .     CPW46B............
                .            .          V
                .            .          V
374             .            .     W46W54
                .            .          .
                .            .          .
381             .            .          .        W47
                .            .          .          .
                .            .          .          .
391             .            .          .          .        W48
                .            .          .          .          .
                .            .          .          .          .
401             .            .          .     CPW47............
                .            .          .          V
                .            .          .          V
403             .            .          .     W47W49
                .            .          .          .
                .            .          .          .
410             .            .          .          .        W50
                .            .          .          .          .
                .            .          .          .          .
420             .            .          .          .          .        W49
                .            .          .          .          .          .
                .            .          .          .          .          .
430             .            .          .     CPW49.......................
                .            .          .          V
                .            .          .          V
432             .            .          .     W49W51
                .            .          .          .
                .            .          .          .
439             .            .          .          .        W51
                .            .          .          .          .
                .            .          .          .          .
449             .            .          .     CPW51............
                .            .          .          .
                .            .          .          .
451             .            .          .          .        W52
                .            .          .          .          .
                .            .          .          .          .
461             .            .          .     CPW52............
                .            .          .          V
                .            .          .          V
463             .            .          .     W52W53
                .            .          .          .
                .            .          .          .
470             .            .          .          .        W53
                .            .          .          .          .
                .            .          .          .          .
480             .            .          .     CPW53............
                .            .          .          .
                .            .          .          .
485             .            .          .          .-------->    RW53
482             .            .          .     DW53RE
                .            .          .          V
                .            .          .          V
488             .            .          .     W53W54
                .            .          .          .
                .            .          .          .
495             .            .          .          .        W54
                .            .          .          .          .
                .            .          .          .          .
505             .            .     CPW54.......................
                .            .          V
                .            .          V
507             .            .     W54W57
                .            .          .
                .            .          .
514             .            .          .        W56
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                .         .         .         .
                .         .         .         .
526             .         .         .         .-------->   RW56
524             .         .         .   DW56RE
                .         .         .        V
                .         .         .        V
529             .         .         .   W56W57
                .         .         .         .
                .         .         .         .
536             .         .         .         .       W55
                .         .         .         .         .
                .         .         .         .         .
548             .         .         .         .         .-------->   DW55S
546             .         .         .         .   DW55RE
                .         .         .         .        V
                .         .         .         .        V
551             .         .         .         .   W55W57
                .         .         .         .         .
                .         .         .         .         .
558             .         .         .         .         .       W57
                .         .         .         .         .         .
                .         .         .         .         .         .
570             .         .         .         .         .         .-------->   RW57
568             .         .         .         .         .   DW57RE
                .         .         .         .         .         .
                .         .         .         .         .         .
573             .         .     CPW57.................................
                .         .         V
                .         .         V
575             .         .     SRW57
                .         .         V
                .         .         V
583             .         .     W57W58
                .         .         .
                .         .         .
589             .         .         .       W58
                .         .         .         .
                .         .         .         .
599             .         .     CPW58............
                .         .         V
                .         .         V
601             .         .     SRW58
                .         .         .
                .         .         .
611             .         .         .-------->   DW58S
609             .         .     DW58SE
                .         .         .
                .         .         .
614             .         .         .       W38
                .         .         .         .
                .         .         .         .
624             .         .     CPW38............
                .         .         .
                .         .         .
628             .         .         .-------->   DW38S
626             .         .     DW38SE
                .         .         V
                .         .         V
631             .         .     W38W37
                .         .         .
                .         .         .
637         CPW37........................
```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	WT3	13.	27.33	12.	9.	3.	21.52		
+	ROUTED TO	21A28A	13.	28.17	12.	9.	3.	21.52		
+	HYDROGRAPH AT	W28A	212.	12.42	25.	6.	2.	.64		
+	2 COMBINED AT	CPW28A	211.	12.42	25.	14.	6.	.84		
+	ROUTED TO	W28A33	152.	12.92	25.	13.	6.	.84		
+	HYDROGRAPH AT	W33	293.	12.42	34.	9.	3.	.84		
+	2 COMBINED AT	CPW33	293.	12.42	58.	21.	9.	1.68		
+	ROUTED TO	W33W35	251.	12.75	58.	21.	9.	1.68		
+	HYDROGRAPH AT	W35	96.	12.42	11.	3.	1.	.28		
+	HYDROGRAPH AT	W34	120.	12.25	14.	4.	1.	.23		
+	ROUTED TO	SRW34	0.	.00	0.	0.	0.	.23		
+	ROUTED TO	W34W35	0.	.00	0.	0.	0.	.23		
+	3 COMBINED AT	CPW35	294.	12.67	68.	24.	9.	2.19		
+	ROUTED TO	W35W36	256.	13.33	67.	23.	9.	2.19		
+	HYDROGRAPH AT	W36	209.	12.50	29.	8.	3.	.72		
+	2 COMBINED AT	CPW36	286.	13.33	94.	30.	12.	2.91		
+	ROUTED TO	W36W37	265.	13.75	93.	30.	12.	2.91		
+	HYDROGRAPH AT	W37	304.	12.58	47.	13.	4.	1.21		
+	HYDROGRAPH AT	W22	434.	12.17	45.	14.	5.	.78		
+	ROUTED TO	W22W23	426.	12.25	45.	14.	5.	.78		
+	HYDROGRAPH AT	W23	486.	12.25	52.	16.	5.	.90		
+	2 COMBINED AT	CPW23	906.	12.25	96.	29.	10.	1.68		
+	ROUTED TO	W23W24	786.	12.33	96.	29.	10.	1.68		
+	HYDROGRAPH AT	W24	260.	12.25	27.	8.	3.	.47		
+	2 COMBINED AT	CPW24	1015.	12.33	123.	37.	12.	2.15		
+	ROUTED TO	W24W27	894.	12.42	123.	37.	12.	2.15		
+	HYDROGRAPH AT	W25	470.	12.33	54.	15.	5.	1.10		
+	ROUTED TO	SRW25	0.	.00	0.	0.	0.	1.10		
+	ROUTED TO	W25W26	0.	.00	0.	0.	0.	1.10		
+	HYDROGRAPH AT	W26	355.	12.33	44.	13.	4.	.68		
+	2 COMBINED AT	CPW26	353.	12.33	44.	13.	4.	1.78		
+	ROUTED TO	SRW26	0.	.00	0.	0.	0.	1.78		
+	ROUTED TO	W26W27	0.	.00	0.	0.	0.	1.78		
+	HYDROGRAPH AT	W27	242.	12.25	24.	7.	2.	.41		
+	3 COMBINED AT	CPW27	1041.	12.33	145.	44.	15.	4.34		
+	ROUTED TO	W27W44	860.	12.50	145.	44.	15.	4.34		
+	HYDROGRAPH AT	W43	273.	12.08	25.	8.	3.	.21		
+	ROUTED TO	SRW43	0.	.00	0.	0.	0.	.21		
+	ROUTED TO	W43W44	0.	.00	0.	0.	0.	.21		
	HYDROGRAPH AT									

```
+                    W44     185.  12.50      23.      6.      2.     .60
     3 COMBINED AT
+                  CPW44    1039.  12.50     168.     49.     16.    5.15
     ROUTED TO
+                 W44W46    1019.  12.58     167.     49.     16.    5.15
     HYDROGRAPH AT
+                    W45     573.  12.33      61.     16.      5.    1.03
     ROUTED TO
+                 W45W46     438.  12.67      61.     16.      5.    1.03
     HYDROGRAPH AT
+                    W46     484.  12.50      65.     19.      6.     .93
     2 COMBINED AT
+                  CPW46A    899.  12.58     125.     34.     11.    1.96
     DIVERSION TO
+                   RW46     390.  12.58      29.      7.      2.    1.96
     HYDROGRAPH AT
+                 DW46RE     509.  12.58      96.     27.      9.    1.96
     2 COMBINED AT
+                  CPW46B   1521.  12.58     262.     76.     25.    7.11
     ROUTED TO
+                 W46W54    1486.  12.67     262.     76.     25.    7.11
     HYDROGRAPH AT
+                    W47     326.  12.25      41.     13.      4.     .67
     HYDROGRAPH AT
+                    W48     185.  12.25      22.      7.      2.     .35
     2 COMBINED AT
+                  CPW47     507.  12.25      63.     19.      6.    1.02
     ROUTED TO
+                 W47W49     427.  12.42      63.     19.      6.    1.02
     HYDROGRAPH AT
+                    W50     441.  12.50      78.     24.      8.    1.35
     HYDROGRAPH AT
+                    W49     204.  12.25      24.      7.      2.     .38
     3 COMBINED AT
+                  CPW49     994.  12.42     163.     50.     17.    2.75
     ROUTED TO
+                 W49W51     893.  12.50     163.     50.     17.    2.75
     HYDROGRAPH AT
+                    W51      58.  12.33       5.      1.      0.     .15
     2 COMBINED AT
+                  CPW51     930.  12.50     168.     51.     17.    2.90
     HYDROGRAPH AT
+                    W52     370.  12.42      52.     15.      5.    1.12
     2 COMBINED AT
+                  CPW52    1264.  12.50     218.     66.     22.    4.02
     ROUTED TO
+                 W52W53    1174.  12.58     218.     66.     22.    4.02
     HYDROGRAPH AT
+                    W53     344.  12.17      25.      7.      2.     .57
     2 COMBINED AT
+                  CPW53    1212.  12.58     242.     72.     24.    4.59
     DIVERSION TO
+                   RW53      54.  12.58       4.      1.      0.    4.59
     HYDROGRAPH AT
+                 DW53RE    1157.  12.58     238.     71.     24.    4.59
     ROUTED TO
+                 W53W54    1055.  12.75     238.     71.     24.    4.59
     HYDROGRAPH AT
+                    W54     469.  12.50      61.     18.      6.     .98
     3 COMBINED AT
+                  CPW54    2777.  12.67     556.    164.     55.   12.68
     ROUTED TO
+                 W54W57    2667.  12.75     556.    164.     55.   12.68
     HYDROGRAPH AT
+                    W56     230.  12.25      16.      4.      1.     .45
     DIVERSION TO
+                   RW56     230.  12.25      16.      4.      1.     .45
     HYDROGRAPH AT
+                 DW56RE       0.    .00       0.      0.      0.     .45
     ROUTED TO
+                 W56W57       0.    .00       0.      0.      0.     .45
     HYDROGRAPH AT
+                    W55     226.  12.25      27.      8.      3.     .50
     DIVERSION TO
+                   DW55S     109.  12.25       5.      1.      0.     .50
     HYDROGRAPH AT
+                 DW55RE     116.  12.25      21.      7.      2.     .50
     ROUTED TO
+                 W55W57     105.  12.67      21.      7.      2.     .50
     HYDROGRAPH AT
+                    W57     614.  12.42      74.     22.      7.    1.16
     DIVERSION TO
+                   RW57     571.  12.33      39.     11.      4.    1.16
     HYDROGRAPH AT
+                 DW57RE     567.  12.50      42.     12.      4.    1.16
     4 COMBINED AT
+                  CPW57    2988.  12.75     615.    182.     61.   14.79
     ROUTED TO
+                  SRW57    2897.  12.83     606.    165.     55.   14.79
     ROUTED TO
+                 W57W58    2899.  12.83     605.    165.     55.   14.79
     HYDROGRAPH AT
+                    W58      80.  12.25       8.      2.      1.     .13
     2 COMBINED AT
+                  CPW58    2907.  12.83     611.    167.     56.   14.92
     ROUTED TO
+                  SRW58    2803.  12.92     611.    167.     56.   14.92
     DIVERSION TO
+                   DW58S    2803.  12.92     611.    167.     56.   14.92
     HYDROGRAPH AT
+                 DW58SE       0.    .00       0.      0.      0.   14.92
     HYDROGRAPH AT
+                    W38     106.  12.42      12.      3.      1.     .25
     2 COMBINED AT
+                  CPW38     102.  12.42      12.      3.      1.   15.17
     DIVERSION TO
+                   DW38S     102.  12.42      12.      3.      1.   15.17
     HYDROGRAPH AT
+                 DW38SE       0.    .00       0.      0.      0.   15.17
     ROUTED TO
+                 W38W37       0.    .00       0.      0.      0.   15.17
     3 COMBINED AT
+                  CPW37     353.  12.75     135.     41.     16.   19.29

*** NORMAL END OF HEC-1 ***
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A.5 EXISTING CONDITIONS WITH PROJECT IN PLACE, 100-YEAR FOR JACKRABBIT CORRIDOR

```
1*****************************************                    ****************************************
 *                                       *                    *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                    *   U.S. ARMY CORPS OF ENGINEERS       *
 *             JUN   1998                *                    *   HYDROLOGIC ENGINEERING CENTER      *
 *           VERSION 4.1                 *                    *         609 SECOND STREET            *
 *                                       *                    *      DAVIS, CALIFORNIA 95616         *
 *  RUN DATE   03APR10  TIME  13:02:50   *                    *          (916) 756-1104              *
 *                                       *                    *                                      *
 *****************************************                    ****************************************


                    X      X  XXXXXXX   XXXXX         X
                    X      X  X        X     X       XX
                    X      X  X        X              X
                    XXXXXXX   XXXX     X      XXXXX   X
                    X      X  X        X              X
                    X      X  X        X     X        X
                    X      X  XXXXXXX   XXXXX        XXX


    THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

    THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
    THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
    NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
    DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
    KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM


1                                         HEC-1 INPUT                                         PAGE  1

 LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

    1          ID             WHITE TANKS AREA, WATERSHED CONTRIBUTING TO FRS#3
    2          ID             PREPARED BY HOSKIN RYAN CONSULTANTS EXCLUSIVELY FOR
    3          ID             FRS#3 OUTLET CHANNEL DESIGN, 04-01-2010
    4          ID             BASED ON HDR LOOP303/WHITE TANKS ADMPU AHA (09-04-09)
    5          ID             HEC-1 MODEL OF EXISTING CONDITIONS WITH CIP
    6          ID             MODIFICATIONS INCLUDE:
    7          ID             (1) UPDATE WITH AVERAGE RAINFALL DEPTH FOR JACKRABBIT CORRIDOR
    8          ID             (2) UPDATE THE PROPOSED CHANNEL DESIGN
    9          ID             (3) DELETE RETENTION OF PASQUELETTI TO REFLECT EXIST CONDITIONS
   10          ID             (4) DELETE BASIN W21A DUE TO THE ADOPTION OF PIPE AT REACH 9
   11          ID
   12          ID             ************************************************************
   13          ID         Flood Control District of Maricopa County
   14          ID         L303_EX_CIP_MB02 - Loop 303/ White Tanks ADMPU AHA
   15          ID         100 YEAR
   16          ID         24 Hour Storm
   17          ID         Unit Hydrograph: S-Graph
   18          ID         08/18/2009
   19          ID             FCDMC CONTRACT 2007C031
   20          ID             BY HDR ENGINEERING (#79902)
   21          ID             EXISTING CONDITIONS WITH CIP-AUGUST 2009
   22          ID             MAJOR BASIN 02
   23          ID             FILE NAME: ECIP-MB2.DAT
   24          IT       5  1JAN99    1200    2000
   25          IN      15
   26          IO       5
               *DIAGRAM
               *
   27          JD   3.661  0.0001
   28          PC   0.000   0.002   0.005   0.008   0.011   0.014   0.017   0.020   0.023   0.026
   29          PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056   0.060
   30          PC   0.064   0.068   0.072   0.076   0.080   0.085   0.090   0.095   0.100   0.105
   31          PC   0.110   0.115   0.120   0.126   0.133   0.140   0.147   0.155   0.163   0.172
   32          PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
   33          PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
   34          PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
   35          PC   0.913   0.918   0.922   0.926   0.930   0.934   0.938   0.942   0.946   0.950
   36          PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977   0.980
   37          PC   0.983   0.986   0.989   0.992   0.995   0.998   1.000
   38          JD   3.478    10.0
               *

   39          KK     WT3
   40          KM   OUTFLOW FROM WT FRS#3 OUTLET
   41          BA   21.52
   42          KO       5
   43          ZR  =QI A=WT B=FRS3 C=FLOW
               *

   44          KK  21A28A   ROUTE
   45          KM   PROPOSED JACKRABBIT CHANNEL, BOTTOM WIDTH=30FT, SIDE SLOPE 6:1
   46          ZW   A=CIP B=21A28A C=FLOW
   47          RS       4    FLOW      -1
   48          RC   0.045   0.035   0.045    3560  0.0010
   49          RX     100     110     120     150     180     210     220     230
1                                         HEC-1 INPUT                                         PAGE  2

 LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

   50          RY    1001    1000    1000     995     995    1000    1000    1001
               *

   51          KK    W28ABASIN
   52          KM        Boundary based on Preliminary Design Plans for
   53          KM        White Tanks FRS #3 Outfall Channel dated
   54          KM        12-08-2008 prepared by Gannett Fleming
   55          BA   0.642
   56          LG    0.34    0.32    4.55    0.35       1
   57          UI       0      65     127     296     444     573     621     609     524     407
   58          UI     308     239     181     135     110      80      64      45      44      16
   59          UI      17      16      16      16      16       0       0       0       0       0
   60          UI       0       0       0       0       0       0       0       0       0       0
   61          UI       0       0       0       0       0       0       0       0       0       0
               *

   62          KK  CPW28ACOMBINE
   63          ZW   A=CIP B=CPW28A C=FLOW
   64          HC       2   0.841
               *

   65          KK  W28A33   ROUTE
   66          KM   PROPOSED JACKRABBIT CHANNEL, BOTTOM WIDTH=40FT, SIDE SLOPE 4:1
   67          ZW   A=CIP B=W28A33 C=FLOW
   68          RS       5    FLOW      -1
   69          RC   0.045   0.035   0.045    4336  0.0010
   70          RX     100     110     120     140     180     200     210     220
   71          RY    1001    1000    1000     995     995    1000    1000    1001
               *

   72          KK    W33BASIN
   73          KM        BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
   74          KM        WOOD/PATEL (2006) MODIFIED SLIGHTLY TO MATCH 1990 2' CI TOPO
   75          ZW   A=CIP B=W33 C=FLOW
   76          BA   0.839
   77          LG    0.31    0.27    4.00    0.47       4
   78          UI       0      92     207     460     670     834     886     810     641     473
   79          UI     361     275     195     155     114      85      63      52      23      22
   80          UI      23      22      23       0       0       0       0       0       0       0
   81          UI       0       0       0       0       0       0       0       0       0       0
   82          UI       0       0       0       0       0       0       0       0       0       0
               *

   83          KK   CPW33COMBINE
   84          ZW   A=CIP B=CPW33 C=FLOW
   85          HC       2    1.68
               *

   86          KK  W33W35   ROUTE
   87          KM   PROPOSED JACKRABBIT CHANNEL, BOTTOM WIDTH=40FT, SIDE SLOPE 6:1
   88          ZW   A=CIP B=W33W35 C=FLOW
   89          RS       3    FLOW      -1
   90          RC   0.045   0.035   0.045    2658  0.0010
   91          RX     100     110     116     152     192     228     240     250
   92          RY    1001    1000    1000     994     994    1000    1000    1001
               *
1                                         HEC-1 INPUT                                         PAGE  3

 LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

   93          KK    W35BASIN
   94          KM        BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
   95          KM        WOOD/PATEL (2006) MODIFIED SLIGHTLY TO MATCH 1990 2' CI TOPO
   96          BA   0.283
   97          LG    0.32    0.34    3.71    0.47       4
   98          UI       0      33      83     180     257     312     308     268     201     146
   99          UI     108      80      58      43      33      22      19       8       8       8
  100          UI       8       8       0       0       0       0       0       0       0       0
  101          UI       0       0       0       0       0       0       0       0       0       0
  102          UI       0       0       0       0       0       0       0       0       0       0
               *

  103          KK    W34BASIN
  104          KM        BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
  105          KM        WOOD/PATEL (2006) MODIFIED SLIGHTLY TO MATCH 1990 2' CI TOPO
  106          BA   0.228
  107          LG    0.32    0.31    3.74    0.46      20
  108          UI       0      33     131     238     312     316     236     162     111      74
  109          UI      52      34      23      13       9       8       9       0       0       0
  110          UI       0       0       0       0       0       0       0       0       0       0
  111          UI       0       0       0       0       0       0       0       0       0       0
  112          UI       0       0       0       0       0       0       0       0       0       0
               *

  113          KK   SRW34STORAGE
  114          KM        Master Drainage Plan for the Caterpillar Property (Basin #29)
  115          KO
  116          RS       1    STOR
```

```
 117        SV          0.99   12.73   23.45   36.25   50.68   54.76   59.33   83.20
 118        SQ                                                          88.00 6226.00
 119        SE  1164.5 1166.00 1170.00 1172.00 1174.00 1176.00 1177.50 1178.00 1180.00
 120        ST
            *

 121        KK  W34W35ROUTE
 122        KM        Cross-section: Estimated 3' deep and 4:1 side slopes, width based on
 123        KM        aerial. Manning's N Value: clean straight earth
 124        RS       1    FLOW
 125        RC   0.022   0.022   0.022     813  0.0111    0.00
 126        RX  100.00  104.00  108.00  120.00  132.00  144.00  152.00  160.00
 127        RY  1166.2 1166.10 1166.00 1160.00 1160.10 1162.00 1162.10 1162.20
            *

 128        KK   CPW35COMBINE
 129        ZW   A=CIP B=CPW35 C=FLOW
 130        HC       3   2.191
            *

 131        KK  W35W36   ROUTE
 132        KM   PROPOSED JACKRABBIT CHANNEL, BOTTOM WIDTH=40FT, SIDE SLOPE 4:1
 133        ZW   A=CIP B=W35W36 C=FLOW
 134        RS       7    FLOW      -1
 135        RC   0.045   0.035   0.045    6051  0.0010
 136        RX     100     110     116     140     180     204     220     230
1                                       HEC-1 INPUT                                        PAGE  4

LINE        ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 137        RY    1001    1000    1000     994     994    1000    1000    1001
            *

 138        KK     W36BASIN
 139        KM        Boundary based on Aerial, topo, and Preliminary
 140        KM        Design Plans for White Tanks FRS #3 Outfall Channel
 141        KM        dated 12-08-2008 prepared by Gannett Fleming
 142        BA   0.720
 143        LG    0.31    0.28    4.00    0.47       4
 144        UI       0      65     101     247     385     507     591     617     609     513
 145        UI     409     329     255     204     160     126     102      76      64      45
 146        UI      45      25      16      16      15      16      16      16       0       0
 147        UI       0       0       0       0       0       0       0       0       0       0
 148        UI       0       0       0       0       0       0       0       0       0       0
            *

 149        KK   CPW36COMBINE
 150        ZW   A=CIP B=CPW36 C=FLOW
 151        HC       2   2.911
            *

 152        KK  W36W37   ROUTE
 153        KM   PROPOSED JACKRABBIT CHANNEL, BOTTOM WIDTH=30FT, SIDE SLOPE 4:1
 154        ZW   A=CIP B=W36W37 C=FLOW
 155        RS       5    FLOW      -1
 156        RC   0.045   0.035   0.045    4527  0.0010
 157        RX     100     110     122     150     178     210     220     230
 158        RY    1001    1000    1000     993     993    1000    1000    1001
            *

 159        KK     W37BASIN
 160        KM        WESTERN LIMIT DEFINED BY JACKRABBIT WASH
 161        KM        CAPACITY APPROX 12,000 CFS, VALENCIA HEIGHTS
 162        BA   1.210
 163        LG    0.32    0.31    4.20    0.44       4
 164        UI       0      96     112     318     497     664     822     897     937     893
 165        UI     777     643     515     421     344     278     221     186     148     115
 166        UI     104      69      66      63      23      24      23      24      23      24
 167        UI      24       0       0       0       0       0       0       0       0       0
 168        UI       0       0       0       0       0       0       0       0       0       0
            *

 169        KK     W22BASIN
 170        KM        BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
 171        KM        WOOD/PATEL (2006) MODIFIED SLIGHTLY TO MATCH 1990 2' CI TOPO
 172        BA   0.782
 173        LG    0.35    0.35    4.15    0.44      19
 174        UI       0     237     914    1559    1035     751     503     352     228     158
 175        UI     107      80      37      31      31      31       0       0       0       0
 176        UI       0       0       0       0       0       0       0       0       0       0
 177        UI       0       0       0       0       0       0       0       0       0       0
 178        UI       0       0       0       0       0       0       0       0       0       0
            *
1                                       HEC-1 INPUT                                        PAGE  5

LINE        ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 179        KK  W22W23ROUTE
 180        KM        Cross-section: Based on aerial and topo
 181        KM        Manning's N Value: pavement and natural desert wash w/ vegetation
 182        RS       1    FLOW
 183        RC   0.035   0.013   0.035    4866  0.0719    0.00
 184        RX  100.00  112.00  113.00  126.00  439.00  477.00  496.00  515.00
 185        RY  1820.0 1815.00 1810.00 1800.00 1799.90 1810.00 1815.00 1820.00
            *

 186        KK     W23BASIN
 187        KM        BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
 188        KM        WOOD/PATEL (2006) MODIFIED SLIGHTLY TO MATCH 1990 2' CI TOPO
 189        BA   0.897
 190        LG    0.35    0.35    4.35    0.40      18
 191        UI       0     236     906    1581    1306     885     636     424     309     204
 192        UI     145      98      80      33      34      33      33       0       0       0
 193        UI       0       0       0       0       0       0       0       0       0       0
 194        UI       0       0       0       0       0       0       0       0       0       0
 195        UI       0       0       0       0       0       0       0       0       0       0
            *

 196        KK   CPW23COMBINE
 197        HC       2   1.679
            *

 198        KK  W23W24ROUTE
 199        KM        Cross-section: Based on aerial and topo
 200        KM        Manning's N Value: natural desert wash w/ vegetation
 201        RS       1    FLOW
 202        RC   0.045   0.035   0.045    5335  0.0367    0.00
 203        RX  100.00  120.00  140.00  180.00  220.00  240.00  260.00  280.00
 204        RY  1462.0 1461.00 1460.00 1450.00 1450.10 1460.00 1461.00 1462.00
            *

 205        KK     W24BASIN
 206        KM        BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
 207        KM        WOOD/PATEL (2006) MODIFIED SLIGHTLY TO MATCH 1990 2' CI TOPO
 208        BA   0.475
 209        LG    0.35    0.35    4.90    0.29      14
 210        UI       0      88     342     575     788     483     372     280     201     154
 211        UI     104      82      60      39      38      15      14      15      15       0
 212        UI       0       0       0       0       0       0       0       0       0       0
 213        UI       0       0       0       0       0       0       0       0       0       0
 214        UI       0       0       0       0       0       0       0       0       0       0
            *

 215        KK   CPW24COMBINE
 216        HC       2   2.154
            *
1                                       HEC-1 INPUT                                        PAGE  6

LINE        ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 217        KK  W24W27ROUTE
 218        KM        Cross-section: Based on aerial and topo
 219        KM        Manning's N Value: natural desert wash w/ vegetation
 220        RS       1    FLOW
 221        RC   0.035   0.035   0.035    5873  0.0289    0.00
 222        RX  100.00  120.00  140.00  160.00  180.00  200.00  220.00  240.00
 223        RY  1094.0 1092.00 1090.00 1084.00 1084.10 1090.00 1090.25 1090.50
            *

 224        KK     W25BASIN
 225        KM        BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
 226        KM        WOOD/PATEL (2006) MODIFIED SLIGHTLY TO MATCH 1990 2' CI TOPO
 227        BA   1.099
 228        LG    0.35    0.35    4.80    0.30       8
 229        UI       0     143     438     866    1174    1490     915     737     620     467
 230        UI     358     307     216     171     140     110      76      71      53      27
 231        UI      28      28      27      28       0       0       0       0       0       0
 232        UI       0       0       0       0       0       0       0       0       0       0
 233        UI       0       0       0       0       0       0       0       0       0       0
            *

 234        KK   SRW25STORAGE
 235        KM        Verrado on-line storage basin (WoodPatel ID SR20)
 236        KO
 237        RS       1    STOR
 238        SV            1.05    9.43   26.91   54.31   92.89  138.67  176.47  190.08  219.05
 239        SQ                                                                  265.00 1377.00
 240        SE  1443.0 1446.00 1450.00 1454.00 1458.00 1462.00 1466.00 1469.00 1470.00 1472.00
 241        ST
            *

 242        KK  W25W26ROUTE
 243        KM        Cross-section: Based on aerial and topo
 244        KM        Manning's N Value: natural desert wash w/ vegetation
 245        RS       1    FLOW
 246        RC   0.035   0.035   0.035    6978  0.0178    0.00
 247        RX  100.00  120.00  140.00  156.00  176.00  192.00  212.00  232.00
 248        RY  1451.5 1451.25 1451.00 1447.00 1447.10 1451.00 1451.25 1451.50
            *

 249        KK     W26BASIN
 250        KM        BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
 251        KM        WOOD/PATEL (2006) MODIFIED SLIGHTLY TO MATCH 1990 2' CI TOPO
 252        BA   0.682
 253        LG    0.33    0.37    6.20    0.17      15
 254        UI       0      86     245     500     680     926     574     465     390     304
 255        UI     231     197     152     110      95      69      59      43      42      21
 256        UI      17      16      17      16      17       0       0       0       0       0
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 257          UI      0       0       0       0       0       0       0       0       0       0
 258          UI      0       0       0       0       0       0       0       0       0       0
              *
1                                     HEC-1 INPUT                                             PAGE  7

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 259          KK   CPW26COMBINE
 260          HC       2   1.781
              *

 261          KK   SRW26STORAGE
 262          KM         Verrado on-line storage basin (WoodPatel ID SR21 and PH 6 Golf)
 263          KO
 264          RS       1     STOR
 265          SV             0.68   20.68   57.58   95.91  102.34  117.65  130.00
 266          SQ                                            265.00 1377.00 2000.00
 267          SE  1319.0 1320.00 1330.00 1340.00 1347.00 1348.00 1350.00 1351.00
 268          ST
              *

 269          KK  W26W27ROUTE
 270          KM         Cross-section: based on topo and aerial
 271          KM         Manning's N Value: natural desert wash w/ vegetation
 272          RS       1     FLOW
 273          RC   0.035   0.035   0.035    3484  0.0172    0.00
 274          RX  100.00  120.00  140.00  152.00  168.00  180.00  200.00  220.00
 275          RY  1298.5 1298.25 1298.00 1294.00 1294.10 1298.00 1298.25 1298.50
              *

 276          KK     W27BASIN
 277          KM         BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
 278          KM         WOOD/PATEL (2006) MODIFIED SLIGHTLY TO MATCH 1990 2' CI TOPO
 279          BA   0.411
 280          LG    0.32    0.37    5.80    0.20      11
 281          UI       0      76     296     498     681     418     323     241     174     133
 282          UI      91      71      51      34      33      13      13      13      13       0
 283          UI       0       0       0       0       0       0       0       0       0       0
 284          UI       0       0       0       0       0       0       0       0       0       0
 285          UI       0       0       0       0       0       0       0       0       0       0
              *

 286          KK   CPW27COMBINE
 287          HC       3   4.345
              *

 288          KK  W27W44ROUTE
 289          KM         Cross-section: Clean straight earth
 290          RS       1     FLOW
 291          RC   0.022   0.022   0.022    7169  0.0098    0.00
 292          RX  100.00  182.00  270.00  288.00  318.00  329.00  333.00  338.00
 293          RY  1256.0 1254.00 1250.00 1248.00 1248.00 1250.00 1254.00 1256.00
              *

 294          KK     W43BASIN
 295          KM         BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
 296          KM         WOOD/PATEL (2006) MODIFIED SLIGHTLY TO MATCH 1990 2' CI TOPO
 297          BA   0.209
 298          LG    0.20    0.28    3.48    0.55      61
 299          UI       0     971     508     111       0       0       0       0       0       0
 300          UI       0       0       0       0       0       0       0       0       0       0
1                                     HEC-1 INPUT                                             PAGE  8

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 301          UI       0       0       0       0       0       0       0       0       0       0
 302          UI       0       0       0       0       0       0       0       0       0       0
 303          UI       0       0       0       0       0       0       0       0       0       0
              *

 304          KK   SRW43STORAGE
 305          KM         Verrado on-line storage basin (WLB) (WoodPatel ID SR23)
 306          KO
 307          RS       1     STOR
 308          SV             6.04   20.38   53.82  120.38  216.24  325.98  455.42  606.10  645.49
 309          SQ
 310          SE  1272.0 1276.00 1280.00 1284.00 1288.00 1292.00 1296.00 1300.00 1304.00 1305.00
 311          ST
              *

 312          KK  W43W44ROUTE
 313          KM         Cross-section: Side slopes and width based on aerial and topo
 314          KM         Manning's N Value: natural desert wash w/ vegetation
 315          RS       1     FLOW
 316          RC   0.035   0.035   0.035    8415  0.0125    0.00
 317          RX  100.00  145.00  180.00  210.00  220.00  245.00  270.00  295.00
 318          RY  1266.0 1264.00 1262.00 1258.00 1258.00 1262.00 1265.50 1266.00
              *

 319          KK     W44BASIN
 320          KM         BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
 321          KM         WOOD/PATEL (2006) MODIFIED SLIGHTLY TO MATCH 1990 2' CI TOPO
 322          BA   0.598
 323          LG    0.35    0.35    4.90    0.29       0
 324          UI       0      55      89     214     334     438     500     527     506     421
 325          UI     332     266     206     162     127      99      82      59      48      37
 326          UI      37      13      14      13      14      13      14       0       0       0
 327          UI       0       0       0       0       0       0       0       0       0       0
 328          UI       0       0       0       0       0       0       0       0       0       0
              *

 329          KK   CPW44COMBINE
 330          HC       3   5.153
              *

 331          KK  W44W46ROUTE
 332          KM         Cross-section: Estimated 2' deep, side slopes and width based on aerial
 333          KM         and topo. Manning's N Value: earth w/ sparse trees and shrubs
 334          RS       1     FLOW
 335          RC   0.032   0.032   0.032    1706  0.0070    0.00
 336          RX  100.00  116.00  132.00  162.00  192.00  252.00  272.00  292.00
 337          RY  1216.0 1215.00 1214.00 1208.00 1208.10 1210.00 1211.00 1212.00
              *

 338          KK     W45BASIN
 339          KM         BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
 340          KM         WOOD/PATEL (2006) MODIFIED SLIGHTLY TO MATCH 1990 2' CI TOPO
 341          BA   1.035
 342          LG    0.35    0.33    7.30    0.11       3
 343          UI       0     136     414     824    1120    1399     860     697     573     441
1                                     HEC-1 INPUT                                             PAGE  9

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 344          UI     336     286     202     161     130     104      71      67      47      26
 345          UI      26      26      26      26       0       0       0       0       0       0
 346          UI       0       0       0       0       0       0       0       0       0       0
 347          UI       0       0       0       0       0       0       0       0       0       0
              *

 348          KK  W45W46ROUTE
 349          KM         Cross-section: Based on aerial and topo
 350          KM         Manning's N Value: natural desert wash w/ vegetation
 351          RS       4     FLOW
 352          RC   0.035   0.035   0.035    9372  0.0125    0.00
 353          RX  100.00  160.00  205.00  265.00  285.00  310.00  345.00  385.00
 354          RY  1274.0 1270.00 1268.00 1262.00 1262.10 1272.00 1275.50 1276.00
              *

 355          KK     W46BASIN
 356          KM         BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
 357          KM         WOOD/PATEL (2006) MODIFIED SLIGHTLY TO MATCH 1990 2' CI TOPO
 358          BA   0.926
 359          LG    0.27    0.29    6.40    0.18      16
 360          UI       0      88     165     367     477     592     749    1082     916     727
 361          UI     580     459     331     180     148      97      75      27      27      27
 362          UI      28      27       0       0       0       0       0       0       0       0
 363          UI       0       0       0       0       0       0       0       0       0       0
 364          UI       0       0       0       0       0       0       0       0       0       0
              *

 365          KK  CPW46ACOMBINE
 366          HC       2   1.961
              *

 367          KK  DW46REDIVERT
 368          KM         Master Drainage Plan for the Caterpillar Property (Basin #27)
 369          DT    RW46     0.0     0.0
 370          DI     0.0    35.0    98.0   179.0   276.0   520.0   888.0  1339.0  1859.0  2439.0
 371          DQ     0.0     0.0     0.0     0.0     0.0   135.0   382.0   701.0  1080.0  1509.0
              *

 372          KK  CPW46BCOMBINE
 373          HC       2   7.114
              *

 374          KK  W46W54ROUTE
 375          KM         Cross-section: side slopes, width based on aerial and topo
 376          KM         Manning's N Value: natural desert wash w/ vegetation
 377          RS       1     FLOW
 378          RC   0.035   0.035   0.035    3908  0.0397    0.00
 379          RX  100.00  112.00  124.00  140.00  160.00  190.00  220.00  240.00
 380          RY  1194.5 1194.00 1190.00 1184.00 1184.10 1186.00 1190.00 1190.50
              *
1                                     HEC-1 INPUT                                             PAGE 10

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 381          KK     W47BASIN
 382          KM         BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
 383          KM         WOOD/PATEL (2006) MODIFIED SLIGHTLY TO MATCH 1990 2' CI TOPO
 384          BA   0.666
 385          LG    0.35    0.35    3.95    0.40      20
 386          UI       0      96     349     638     936     788     540     432     340     243
 387          UI     202     142     111      83      66      47      43      19      19      18
 388          UI      19      18       0       0       0       0       0       0       0       0
 389          UI       0       0       0       0       0       0       0       0       0       0
 390          UI       0       0       0       0       0       0       0       0       0       0
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                *
391             KK     W48BASIN
392             KM        BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
393             KM        WOOD/PATEL (2006) MODIFIED SLIGHTLY TO MATCH 1990 2' CI TOPO
394             BA   0.353
395             LG    0.35    0.35    3.95    0.40      20
396             UI       0      57     232     395     573     367     281     216     157     124
397             UI      85      65      48      36      28      20      10      11      11      11
398             UI       0       0       0       0       0       0       0       0       0       0
399             UI       0       0       0       0       0       0       0       0       0       0
400             UI       0       0       0       0       0       0       0       0       0       0
                *

401             KK   CPW47COMBINE
402             HC       2   1.019
                *

403             KK  W47W49ROUTE
404             KM        Cross-section: Based on aerial and topo
405             KM        Manning's N Value: natural desert wash w/ vegetation
406             RS       1    FLOW
407             RC   0.035   0.035   0.035    5077  0.0414    0.00
408             RX  100.00  150.00  190.00  210.00  235.00  255.00  275.00  310.00
409             RY  1740.0 1720.00 1710.00 1707.00 1708.00 1714.00 1730.00 1740.00
                *

410             KK     W50BASIN
411             KM        BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
412             KM        WOOD/PATEL (2006) MODIFIED SLIGHTLY TO MATCH 1990 2' CI TOPO
413             BA   1.345
414             LG    0.35    0.35    4.25    0.42      19
415             UI       0     122     193     458     725     898    1129    1321     842     706
416             UI     619     546     461     378     312     278     240     189     156     135
417             UI     120      93      88      60      60      59      35      24      23      24
418             UI      23      24      24      23      23       0       0       0       0       0
419             UI       0       0       0       0       0       0       0       0       0       0
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LINE            ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

420             KK     W49BASIN
421             KM        BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
422             KM        WOOD/PATEL (2006) MODIFIED SLIGHTLY TO MATCH 1990 2' CI TOPO
423             BA   0.385
424             LG    0.35    0.35    3.95    0.40      20
425             UI       0      67     265     450     633     398     302     232     166     129
426             UI      89      70      48      35      31      16      12      12      12      11
427             UI       0       0       0       0       0       0       0       0       0       0
428             UI       0       0       0       0       0       0       0       0       0       0
429             UI       0       0       0       0       0       0       0       0       0       0
                *

430             KK   CPW49COMBINE
431             HC       3   2.749
                *

432             KK  W49W51ROUTE
433             KM        Cross-section: side slopes, width based on aerial and topo
434             KM        Manning's N Value: natural desert wash w/ vegetation
435             RS       1    FLOW
436             RC   0.035   0.035   0.035    5726  0.0253    0.00
437             RX  100.00  150.00  220.00  236.00  286.00  300.00  340.00  380.00
438             RY  1485.0 1482.00 1479.00 1476.00 1476.10 1479.00 1485.00 1490.00
                *

439             KK     W51BASIN
440             KM        BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
441             KM        WOOD/PATEL (2006) MODIFIED SLIGHTLY TO MATCH 1990 2' CI TOPO
442             BA   0.149
443             LG    0.35    0.35    3.85    0.43       1
444             UI       0      21      74     140     188     200     165     113      79      55
445             UI      38      26      18      14       5       5       5       5       0       0
446             UI       0       0       0       0       0       0       0       0       0       0
447             UI       0       0       0       0       0       0       0       0       0       0
448             UI       0       0       0       0       0       0       0       0       0       0
                *

449             KK   CPW51COMBINE
450             HC       2   2.898
                *

451             KK     W52BASIN
452             KM        BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
453             KM        WOOD/PATEL (2006) MODIFIED SLIGHTLY TO MATCH 1990 2' CI TOPO
454             BA   1.123
455             LG    0.35    0.35    4.40    0.38       9
456             UI       0     116     224     522     764     958    1288     824     673     577
457             UI     489     413     317     275     240     179     147     128     100      88
458             UI      67      57      56      35      22      22      22      22      22      22
459             UI      22       0       0       0       0       0       0       0       0       0
460             UI       0       0       0       0       0       0       0       0       0       0
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LINE            ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

461             KK   CPW52COMBINE
462             HC       2   4.021
                *

463             KK  W52W53ROUTE
464             KM        Cross-section: Estimated 3' deep and 4:1 side slopes, width based on
465             KM        aerial. Manning's N Value: natural desert wash w/ vegetation
466             RS       1    FLOW
467             RC   0.035   0.035   0.035    4917  0.0112    0.00
468             RX  100.00  118.00  124.00  130.00  146.00  150.00  164.00  182.00
469             RY  1375.0 1373.00 1370.00 1368.00 1368.00 1370.00 1373.00 1375.00
                *

470             KK     W53BASIN
471             KM        BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
472             KM        WOOD/PATEL (2006) MODIFIED SLIGHTLY TO MATCH 1990 2' CI TOPO
473             BA   0.568
474             LG    0.30    0.32    4.45    0.42       7
475             UI       0     223     858    1219     946     528     288     161      89      32
476             UI      31       0       0       0       0       0       0       0       0       0
477             UI       0       0       0       0       0       0       0       0       0       0
478             UI       0       0       0       0       0       0       0       0       0       0
479             UI       0       0       0       0       0       0       0       0       0       0
                *

480             KK   CPW53COMBINE
481             HC       2   4.589
                *

482             KK  DW53REDIVERT
483             KM        Verrado - Planning Unti Drainage Plan for Portions of Planning Unit V
484             KM        (2nd Submittal) (ESTIMATED FROM GOLF BASINS IN REPORT)
485             DT    RW53     0.0     0.0
486             DI     0.0  1000.0  1500.0  2000.0  2500.0  3000.0  3500.0  4000.0  4145.0  4500.0
487             DQ     0.0    10.0   115.0   290.0   460.0   715.0   980.0  1100.0  1145.0  1260.0
                *

488             KK  W53W54ROUTE
489             KM        Cross-section: side slopes, width based on aerial and topo
490             KM        Manning's N Value: natural desert wash w/ vegetation
491             RS       2    FLOW
492             RC   0.035   0.035   0.035    9900  0.0157    0.00
493             RX  100.00  124.00  144.00  150.00  160.00  190.00  220.00  240.00
494             RY  1194.5 1194.00 1190.00 1184.00 1184.10 1186.00 1190.00 1190.50
                *

495             KK     W54BASIN
496             KM        BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
497             KM        WOOD/PATEL (2006) MODIFIED SLIGHTLY TO MATCH 1990 2' CI TOPO
498             BA   0.980
499             LG    0.23    0.26    4.50    0.43      18
500             UI       0     105     248     485     621     807    1191    1143     882     676
501             UI     520     329     183     143     104      33      32      32      33       0
502             UI       0       0       0       0       0       0       0       0       0       0
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LINE            ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

503             UI       0       0       0       0       0       0       0       0       0       0
504             UI       0       0       0       0       0       0       0       0       0       0
                *

505             KK   CPW54COMBINE
506             HC       3  12.683
                *

507             KK  W54W57ROUTE
508             KM        Cross-section: side slopes and width based on aerial
509             KM        Manning's N Value: natural desert wash w/ vegetation
510             RS       1    FLOW
511             RC   0.035   0.035   0.035    5173  0.0151    0.00
512             RX  100.00  124.00  144.00  156.00  180.00  204.00  216.00  228.00
513             RY  1126.0 1125.00 1124.00 1114.00 1114.10 1117.00 1117.50 1118.00
                *

514             KK     W56BASIN
515             KM        BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
516             KM        WOOD/PATEL (2006) MODIFIED SLIGHTLY TO MATCH 1990 2' CI TOPO
517             BA   0.448
518             LG    0.17    0.28    4.20    0.61       5
519             UI       0     143     474     812     956     583     279     126      47      28
520             UI       0       0       0       0       0       0       0       0       0       0
521             UI       0       0       0       0       0       0       0       0       0       0
522             UI       0       0       0       0       0       0       0       0       0       0
523             UI       0       0       0       0       0       0       0       0       0       0
                *

524             KK  DW56REDIVERT
525             KM        Sienna Hills (aka Tesota Hills) Preliminary Drainage Report
526             DT    RW56    35.6     0.0
```

```
 527          DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
 528          DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
              *

 529          KK  W56W57ROUTE
 530          KM        Cross-section: Estimated 3' deep and 4:1 side slopes, width
 531          KM        based on aerial / Manning's N Value: clean straight earth
 532          RS       1    FLOW
 533          RC   0.022   0.022   0.022    4948  0.0038    0.00
 534          RX  100.00  108.00  116.00  128.00  131.00  143.00  153.00  163.00
 535          RY  1108.5 1108.25 1108.00 1105.00 1105.10 1108.00 1108.25 1108.50
              *

 536          KK     W55BASIN
 537          KM        BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
 538          KM        WOOD/PATEL (2006) MODIFIED SLIGHTLY TO MATCH 1990 2' CI TOPO
 539          BA   0.496
 540          LG    0.32    0.33    4.00    0.50      17
 541          UI       0      80     326     555     806     516     393     304     221     173
 542          UI     120      92      67      51      38      29      15      15      15      15
 543          UI       0       0       0       0       0       0       0       0       0       0
 544          UI       0       0       0       0       0       0       0       0       0       0
 545          UI       0       0       0       0       0       0       0       0       0       0
              *
1                                          HEC-1 INPUT                                          PAGE 14
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 546          KK  DW55REDIVERT
 547          KM        Verado GOB5
 548          DT   DW55S     0.0     0.0
 549          DI     0.0    55.0   101.0   537.0  1297.0  2269.0  4708.0  7684.0 11074.0     0.0
 550          DQ     0.0     0.0     0.0   382.0  1080.0  1984.0  4269.0  7072.0 10310.0     0.0
              *

 551          KK  W55W57ROUTE
 552          KM        Cross-section: Estimated 2' deep and 4:1 side slopes, width
 553          KM        based on aerial / Manning's N Value: natural desert wash w/ vegetation
 554          RS       4    FLOW
 555          RC   0.035   0.035   0.035    5747  0.0096    0.00
 556          RX  100.00  110.00  120.00  136.00  156.00  172.00  192.00  212.00
 557          RY  1136.5 1136.25 1136.00 1134.00 1134.10 1136.00 1136.25 1136.50
              *

 558          KK     W57BASIN
 559          KM        BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
 560          KM        WOOD/PATEL, 2006 MODIFIED SLIGHTLY TO MATCH NEW TOPO
 561          BA   1.161
 562          LG    0.27    0.29    4.65    0.37      19
 563          UI       0     138     388     695     889    1284    1641    1231     946     700
 564          UI     409     239     166     101      43      43      42       0       0       0
 565          UI       0       0       0       0       0       0       0       0       0       0
 566          UI       0       0       0       0       0       0       0       0       0       0
 567          UI       0       0       0       0       0       0       0       0       0       0
              *

 568          KK  DW57REDIVERT
 569          KM        Master Drainage Plan for the Caterpillar Property (Basin #42)
 570          DT    RW57    21.6     0.0
 571          DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
 572          DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
              *

 573          KK   CPW57COMBINE
 574          HC       4  14.788
              *

 575          KK   SRW57STORAGE
 576          KM        Verrado SR42
 577          KO
 578          RS       1    STOR
 579          SV           24.40   29.60   35.70   42.00   48.50   55.20   62.20   69.30   76.70
 580          SQ                                  368.00 1040.00 1912.00 2944.00 4114.00 5410.00
 581          SE  1084.0 1090.00 1091.00 1092.00 1093.00 1094.00 1095.00 1096.00 1097.00 1098.00
 582          ST
              *
1                                          HEC-1 INPUT                                          PAGE 15
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 583          KK  W57W58ROUTE
 584          KM        Cross-section: Taken from aerial and topo
 585          RS       1    FLOW
 586          RC   0.022   0.022   0.022    1236  0.0067    0.00
 587          RX  100.00  115.50  121.80  142.00  179.30  191.30  199.60  207.80
 588          RY  1072.0 1070.00 1064.00 1062.00 1061.90 1064.00 1065.00 1066.00
              *

 589          KK     W58BASIN
 590          KM        BASIN BOUNDARY VARIES FROM VERRADO DEVEL.COND.PLAN WOOD/PATEL 2006
 591          KM        NEW 2' CI TOPO OBTAINED 2008
 592          BA   0.131
 593          LG    0.30    0.33    4.65    0.35      18
 594          UI       0      25     101     176     208     180     117      75      48      32
 595          UI      19      14       5       5       6       0       0       0       0       0
 596          UI       0       0       0       0       0       0       0       0       0       0
 597          UI       0       0       0       0       0       0       0       0       0       0
 598          UI       0       0       0       0       0       0       0       0       0       0
              *

 599          KK   CPW58COMBINE
 600          HC       2  14.919
              *

 601          KK   SRW58STORAGE
 602          KM        Storage based on new topo section calculations
 603          KO
 604          RS       1    STOR
 605          SV            0.17    2.57    5.40   13.08   31.52   47.89   64.25  111.96  171.81
 606          SQ                  784.10 2217.60 3099.20 3799.80 4122.90 4540.00 6878.8012249.90
 607          SE  1084.0 1086.00 1088.00 1090.00 1092.00 1094.00 1095.00 1096.00 1098.00 1100.00
 608          ST
              *

 609          KK  DW58SEDIVERT
 610          KM        Divert is stage storage on 4-10x8 boxes under I-10. Diverted flow goes s
 611          DT   DW58S     0.0     0.0
 612          DI     0.0   100.0  2000.0  4100.0  4200.0  5000.0  6000.0  7000.0  8000.0  9000.0
 613          DQ     0.0   100.0  2000.0  4100.0  4195.5  4606.7  4833.2  4983.7  5102.6  5203.3
              *

 614          KK     W38BASIN
 615          KM        BASIN BOUNDARY FORMED BY MCDOWELL, I-10, JACKRABBIT
 616          KM        AND TUTHILL, DETAILED I-10 TOPO AND CULVERT INFO
 617          BA   0.251
 618          LG    0.32    0.32    4.65    0.33       7
 619          UI       0      30      77     163     235     279     279     236     174     127
 620          UI      93      68      51      36      27      20      14       7       7       8
 621          UI       7       0       0       0       0       0       0       0       0       0
 622          UI       0       0       0       0       0       0       0       0       0       0
 623          UI       0       0       0       0       0       0       0       0       0       0
              *
1                                          HEC-1 INPUT                                          PAGE 16
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 624          KK   CPW38COMBINE
 625          HC       2   15.17
              *

 626          KK  DW38SEDIVERT
 627          KM        Full flow capacity of culverts under I-10 is diverted flow
 628          DT   DW38S     0.0     0.0
 629          DI     0.0   100.0   200.0   300.0   400.0   467.0   500.0   800.0  1000.0 10000.0
 630          DQ     0.0   100.0   200.0   300.0   400.0   467.0   467.0   467.0   467.0   467.0
              *

 631          KK  W38W37ROUTE
 632          KM        Cross section based from 1990 topo, Manning's N Value: clean earth
 633          RS       3    FLOW
 634          RC   0.022   0.022   0.022    2849  0.0053    0.00
 635          RX  100.00  204.00  440.00  608.00  687.00  700.00  736.00  759.00
 636          RY  1083.0 1082.00 1080.00 1078.00 1078.00 1080.00 1082.00 1083.00
              *

 637          KK   CPW37COMBINE
 638          ZW   A=CIP B=CPW37 C=FLOW
 639          HC       3  19.291
              *
 640          ZZ
1
                 SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
 LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

 NO.       (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

 39          WT3
               V
               V
 44        21A28A
               .
               .
 51            .        W28A
               .          .
               .          .
 62        CPW28A............
               V
               V
 65        W28A33
               .
               .
 72            .         W33
               .          .
               .          .
 83         CPW33...........
               V
```

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                V
 86       W33W35
                .
                .
 93             .         W35
                .           .
                .           .
103             .           .         W34
                .           .           V
                .           .           V
113             .           .       SRW34
                .           .           V
                .           .           V
121             .           .     W34W35
                .           .           .
                .           .           .
128        CPW35.......................
                V
                V
131       W35W36
                .
                .
138             .         W36
                .           .
                .           .
149        CPW36............
                V
                V
152       W36W37
                .
                .
159             .         W37
                .           .
                .           .
169             .           .         W22
                .           .           V
                .           .           V
179             .           .     W22W23
                .           .           .
                .           .           .
186             .           .           .         W23
                .           .           .           .
                .           .           .           .
196             .           .       CPW23............
                .           .           V
                .           .           V
198             .           .     W23W24
                .           .           .
                .           .           .
205             .           .           .         W24
                .           .           .           .
                .           .           .           .
215             .           .       CPW24............
                .           .           V
                .           .           V
217             .           .     W24W27
                .           .           .
                .           .           .
224             .           .           .         W25
                .           .           .           V
                .           .           .           V
234             .           .           .       SRW25
                .           .           .           V
                .           .           .           V
242             .           .           .     W25W26
                .           .           .           .
                .           .           .           .
249             .           .           .           .         W26
                .           .           .           .           .
                .           .           .           .           .
259             .           .           .       CPW26............
                .           .           .           V
                .           .           .           V
261             .           .           .       SRW26
                .           .           .           V
                .           .           .           V
269             .           .           .     W26W27
                .           .           .           .
                .           .           .           .
276             .           .           .           .         W27
                .           .           .           .           .
                .           .           .           .           .
286             .           .       CPW27........................
                .           .           V
                .           .           V
288             .           .     W27W44
                .           .           .
                .           .           .
294             .           .           .         W43
                .           .           .           V
                .           .           .           V
304             .           .           .       SRW43
                .           .           .           V
                .           .           .           V
312             .           .           .     W43W44
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                .           .           .           .
                .           .           .           .
319             .           .           .           .         W44
                .           .           .           .           .
                .           .           .           .           .
329             .           .       CPW44........................
                .           .           V
                .           .           V
331             .           .     W44W46
                .           .           .
                .           .           .
338             .           .           .       W45
                .           .           .         V
                .           .           .         V
348             .           .           .     W45W46
                .           .           .           .
                .           .           .           .
355             .           .           .           .         W46
                .           .           .           .           .
                .           .           .           .           .
365             .           .           .     CPW46A............
                .           .           .           .
                .           .           .           .
369             .           .           .           .-------->    RW46
367             .           .           .     DW46RE
                .           .           .           .
                .           .           .           .
372             .           .       CPW46B............
                .           .           V
                .           .           V
374             .           .     W46W54
                .           .           .
                .           .           .
381             .           .           .       W47
                .           .           .         .
                .           .           .         .
391             .           .           .         .         W48
                .           .           .         .           .
                .           .           .         .           .
401             .           .           .     CPW47............
                .           .           .         V
                .           .           .         V
403             .           .           .     W47W49
                .           .           .           .
                .           .           .           .
410             .           .           .           .         W50
                .           .           .           .           .
                .           .           .           .           .
420             .           .           .           .           .         W49
                .           .           .           .           .           .
                .           .           .           .           .           .
430             .           .           .     CPW49........................
                .           .           .         V
                .           .           .         V
432             .           .           .     W49W51
                .           .           .           .
                .           .           .           .
439             .           .           .           .         W51
                .           .           .           .           .
                .           .           .           .           .
449             .           .           .     CPW51............
                .           .           .           .
                .           .           .           .
451             .           .           .           .         W52
                .           .           .           .           .
                .           .           .           .           .
461             .           .           .     CPW52............
                .           .           .         V
                .           .           .         V
463             .           .           .     W52W53
                .           .           .           .
                .           .           .           .
470             .           .           .           .         W53
                .           .           .           .           .
                .           .           .           .           .
480             .           .           .     CPW53............
                .           .           .           .
                .           .           .           .
485             .           .           .           .-------->    RW53
482             .           .           .     DW53RE
                .           .           .         V
                .           .           .         V
488             .           .           .     W53W54
                .           .           .           .
                .           .           .           .
495             .           .           .           .         W54
                .           .           .           .           .
                .           .           .           .           .
505             .           .       CPW54........................
                .           .           V
                .           .           V
507             .           .     W54W57
                .           .           .
                .           .           .
514             .           .           .       W56
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                .         .         .         .
                .         .         .         .
526             .         .         .         .-------->   RW56
524             .         .         .     DW56RE
                .         .         .         V
                .         .         .         V
529             .         .         .     W56W57
                .         .         .         .
                .         .         .         .
536             .         .         .         .        W55
                .         .         .         .          .
                .         .         .         .          .
548             .         .         .         .          .-------->   DW55S
546             .         .         .         .     DW55RE
                .         .         .         .          V
                .         .         .         .          V
551             .         .         .         .     W55W57
                .         .         .         .          .
                .         .         .         .          .
558             .         .         .         .          .        W57
                .         .         .         .          .          .
                .         .         .         .          .          .
570             .         .         .         .          .          .-------->   RW57
568             .         .         .         .          .     DW57RE
                .         .         .         .          .          .
                .         .         .         .          .          .
573             .         .     CPW57.................................
                .         .         V
                .         .         V
575             .         .     SRW57
                .         .         V
                .         .         V
583             .         .     W57W58
                .         .         .
                .         .         .
589             .         .         .        W58
                .         .         .         .
                .         .         .         .
599             .         .     CPW58............
                .         .         V
                .         .         V
601             .         .     SRW58
                .         .         .
                .         .         .
611             .         .         .-------->   DW58S
609             .         .     DW58SE
                .         .         .
                .         .         .
614             .         .         .        W38
                .         .         .         .
                .         .         .         .
624             .         .     CPW38............
                .         .         .
                .         .         .
628             .         .         .-------->   DW38S
626             .         .     DW38SE
                .         .         V
                .         .         V
631             .         .     W38W37
                .         .         .
                .         .         .
637             CPW37........................
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(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	WT3	187.	17.00	186.	180.	99.	21.52		
+	ROUTED TO	21A28A	187.	17.42	186.	180.	99.	21.52		
+	HYDROGRAPH AT	W28A	508.	12.42	61.	16.	5.	.64		
+	2 COMBINED AT	CPW28A	507.	12.42	186.	181.	104.	.84		
+	ROUTED TO	W28A33	424.	12.75	186.	180.	104.	.84		
+	HYDROGRAPH AT	W33	685.	12.42	81.	21.	7.	.84		
+	2 COMBINED AT	CPW33	790.	12.58	241.	197.	111.	1.68		
+	ROUTED TO	W33W35	761.	12.75	238.	196.	110.	1.68		
+	HYDROGRAPH AT	W35	233.	12.33	26.	7.	2.	.28		
+	HYDROGRAPH AT	W34	255.	12.25	28.	8.	3.	.23		
+	ROUTED TO	SRW34	0.	.00	0.	0.	0.	.23		
+	ROUTED TO	W34W35	0.	.00	0.	0.	0.	.23		
+	3 COMBINED AT	CPW35	851.	12.67	258.	201.	113.	2.19		
+	ROUTED TO	W35W36	799.	13.08	251.	199.	112.	2.19		
+	HYDROGRAPH AT	W36	496.	12.50	69.	18.	6.	.72		
+	2 COMBINED AT	CPW36	931.	13.08	298.	212.	118.	2.91		
+	ROUTED TO	W36W37	884.	13.33	294.	211.	118.	2.91		
+	HYDROGRAPH AT	W37	736.	12.58	113.	30.	10.	1.21		
+	HYDROGRAPH AT	W22	961.	12.17	92.	27.	9.	.78		
+	ROUTED TO	W22W23	934.	12.25	92.	27.	9.	.78		
+	HYDROGRAPH AT	W23	1064.	12.17	106.	31.	10.	.90		
+	2 COMBINED AT	CPW23	1968.	12.25	198.	58.	19.	1.68		
+	ROUTED TO	W23W24	1783.	12.25	198.	58.	19.	1.68		
+	HYDROGRAPH AT	W24	547.	12.25	57.	16.	5.	.47		
+	2 COMBINED AT	CPW24	2320.	12.25	254.	74.	25.	2.15		
+	ROUTED TO	W24W27	2107.	12.33	254.	74.	25.	2.15		
+	HYDROGRAPH AT	W25	1037.	12.25	120.	32.	11.	1.10		
+	ROUTED TO	SRW25	0.	.00	0.	0.	0.	1.10		
+	ROUTED TO	W25W26	0.	.00	0.	0.	0.	1.10		
+	HYDROGRAPH AT	W26	714.	12.33	92.	26.	9.	.68		
+	2 COMBINED AT	CPW26	710.	12.33	91.	26.	9.	1.78		
+	ROUTED TO	SRW26	0.	.00	0.	0.	0.	1.78		
+	ROUTED TO	W26W27	0.	.00	0.	0.	0.	1.78		
+	HYDROGRAPH AT	W27	495.	12.25	51.	14.	5.	.41		
+	3 COMBINED AT	CPW27	2525.	12.33	303.	87.	29.	4.34		
+	ROUTED TO	W27W44	2142.	12.50	302.	87.	29.	4.34		
+	HYDROGRAPH AT	W43	467.	12.08	41.	14.	5.	.21		
+	ROUTED TO	SRW43	0.	.00	0.	0.	0.	.21		
+	ROUTED TO	W43W44	0.	.00	0.	0.	0.	.21		
	HYDROGRAPH AT									

```
+                    W44     440.  12.50      58.      14.       5.      .60
     3 COMBINED AT
+                   CPW44   2572.  12.50     359.     101.      34.     5.15
     ROUTED TO
+                 W44W46   2548.  12.50     359.     101.      34.     5.15
     HYDROGRAPH AT
+                    W45   1151.  12.25     134.      34.      11.     1.03
     ROUTED TO
+                 W45W46    994.  12.58     134.      34.      11.     1.03
     HYDROGRAPH AT
+                    W46    957.  12.50     130.      37.      12.      .93
     2 COMBINED AT
+                  CPW46A  1918.  12.50     263.      71.      24.     1.96
     DIVERSION TO
+                   RW46   1124.  12.50     108.      27.       9.     1.96
     HYDROGRAPH AT
+                 DW46RE    794.  12.50     155.      44.      15.     1.96
     2 COMBINED AT
+                  CPW46B  3331.  12.50     512.     144.      48.     7.11
     ROUTED TO
+                 W46W54   3283.  12.58     512.     144.      48.     7.11
     HYDROGRAPH AT
+                    W47    692.  12.25      83.      24.       8.      .67
     HYDROGRAPH AT
+                    W48    389.  12.25      44.      13.       4.      .35
     2 COMBINED AT
+                   CPW47   1077.  12.25     127.      37.      12.     1.02
     ROUTED TO
+                 W47W49    998.  12.33     127.      37.      12.     1.02
     HYDROGRAPH AT
+                    W50    971.  12.42     160.      47.      16.     1.35
     HYDROGRAPH AT
+                    W49    430.  12.25      48.      14.       5.      .38
     3 COMBINED AT
+                   CPW49   2214.  12.33     332.      98.      33.     2.75
     ROUTED TO
+                 W49W51   2034.  12.50     332.      98.      33.     2.75
     HYDROGRAPH AT
+                    W51    143.  12.33      13.       3.       1.      .15
     2 COMBINED AT
+                   CPW51   2144.  12.42     345.     101.      34.     2.90
     HYDROGRAPH AT
+                    W52    850.  12.42     117.      32.      11.     1.12
     2 COMBINED AT
+                   CPW52   2980.  12.42     459.     132.      44.     4.02
     ROUTED TO
+                 W52W53   2758.  12.50     459.     132.      44.     4.02
     HYDROGRAPH AT
+                    W53    791.  12.17      57.      15.       5.      .57
     2 COMBINED AT
+                   CPW53   2902.  12.50     514.     147.      49.     4.59
     DIVERSION TO
+                   RW53    665.  12.50      59.      15.       5.     4.59
     HYDROGRAPH AT
+                 DW53RE   2237.  12.50     455.     132.      44.     4.59
     ROUTED TO
+                 W53W54   2116.  12.67     455.     132.      44.     4.59
     HYDROGRAPH AT
+                    W54    957.  12.42     122.      35.      12.      .98
     3 COMBINED AT
+                   CPW54   6076.  12.58    1082.     309.     104.    12.68
     ROUTED TO
+                 W54W57   5911.  12.67    1081.     309.     104.    12.68
     HYDROGRAPH AT
+                    W56    558.  12.25      39.      10.       3.      .45
     DIVERSION TO
+                   RW56    558.  12.25      39.      10.       3.      .45
     HYDROGRAPH AT
+                 DW56RE      0.    .00       0.       0.       0.      .45
     ROUTED TO
+                 W56W57      0.    .00       0.       0.       0.      .45
     HYDROGRAPH AT
+                    W55    507.  12.25      56.      16.       5.      .50
     DIVERSION TO
+                   DW55S    355.  12.25      24.       6.       2.      .50
     HYDROGRAPH AT
+                 DW55RE    151.  12.25      31.      10.       3.      .50
     ROUTED TO
+                 W55W57    136.  12.58      31.      10.       3.      .50
     HYDROGRAPH AT
+                    W57   1251.  12.42     148.      43.      14.     1.16
     DIVERSION TO
+                   RW57    559.  12.08      37.      11.       4.     1.16
     HYDROGRAPH AT
+                 DW57RE   1251.  12.42     121.      32.      11.     1.16
     4 COMBINED AT
+                   CPW57   6785.  12.58    1228.     350.     117.    14.79
     ROUTED TO
+                   SRW57   6604.  12.67    1228.     334.     111.    14.79
     ROUTED TO
+                 W57W58   6575.  12.67    1228.     334.     111.    14.79
     HYDROGRAPH AT
+                    W58    166.  12.25      17.       5.       2.      .13
     2 COMBINED AT
+                   CPW58   6608.  12.67    1243.     338.     113.    14.92
     ROUTED TO
+                   SRW58   5281.  12.92    1244.     338.     113.    14.92
     DIVERSION TO
+                   DW58S   4670.  12.92    1207.     329.     110.    14.92
     HYDROGRAPH AT
+                 DW58SE    611.  12.92      37.       9.       3.    14.92
     HYDROGRAPH AT
+                    W38    237.  12.33      27.       7.       2.      .25
     2 COMBINED AT
+                   CPW38    657.  12.92      63.      16.       5.    15.17
     DIVERSION TO
+                   DW38S    467.  12.83      58.      15.       5.    15.17
     HYDROGRAPH AT
+                 DW38SE    190.  12.92       5.       1.       0.    15.17
     ROUTED TO
+                 W38W37     78.  13.17       5.       1.       0.    15.17
     3 COMBINED AT
+                   CPW37   1073.  13.25     390.     236.     127.    19.29

*** NORMAL END OF HEC-1 ***
```

A.6 FUTURE CONDITIONS 10-YEAR FOR FRS#3 MAJOR BASIN

```
1*****************************************                  ****************************************
 *                                       *                  *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                  *   U.S. ARMY CORPS OF ENGINEERS       *
 *              JUN   1998               *                  *   HYDROLOGIC ENGINEERING CENTER      *
 *            VERSION 4.1                *                  *        609 SECOND STREET             *
 *                                       *                  *     DAVIS, CALIFORNIA 95616          *
 *  RUN DATE   02DEC09  TIME  09:51:06   *                  *         (916) 756-1104               *
 *                                       *                  *                                      *
 *****************************************                  ****************************************


                         X     X  XXXXXXX   XXXXX          X
                         X     X  X        X     X        XX
                         X     X  X        X               X
                         XXXXXXX  XXXX     X       XXXXX   X
                         X     X  X        X               X
                         X     X  X        X     X         X
                         X     X  XXXXXXX   XXXXX         XXX


        THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

        THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
        THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
        NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
        DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
        KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                         HEC-1 INPUT                                             PAGE  1

        LINE      ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

          1       ID           FUTURE CONDITION 10-YEAR 24HOUR EVENT
          2       ID           PRECIPITATION FROM DDMSW
          3       ID           WHITE TANKS AREA, WATERSHED CONTRIBUTING TO FRS#3
          4       ID           PREPARED BY HOSKIN RYAN CONSULTANTS EXCLUSIVELY FOR
          5       ID           FRS#3 OUTLET CHANNEL DESIGN, 12-02-2009
          6       ID           BASED ON HDR HEC-1 MODEL OF FUTURE CONDITION WITH CIP
          7       ID           MODIFICATIONS INCLUDE:
          8       ID           (1) UPDATE WITH AVERAGE RAINFALL DEPTH FOR FRS#3 WATERSHED ONLY
          9       ID           (2) UPDATE THE STAGE-STORAGE-DISCHARGE CURVE BASED ON URS DESIGN
         10       ID               OF FRS#3 PRINCIPAL AND EMERGENCY SPILLWAY (DISCHARGE
         11       ID               INCLUDING INFILTRATION)
         12       ID           (3) SEPARATE FRS#3 OUTFLOW AND INFILTRATION
         13       ID       ***********************************************************
         14       ID         Flood Control District of Maricopa County
         15       ID         FU_CIP_MB02 - Loop 303/ White Tanks ADMPU AHA
         16       ID         Major Basin: 02
         17       ID         100 Year - Return Period
         18       ID         24 Hour Storm
         19       ID         Multiple Storms
         20       ID         Unit Hydrograph: S-Graph
         21       ID         03/08/2009
         22       IT       5  1JAN99    1200    2000
         23       IN      15
         24       IO       5
                  *DIAGRAM
                  *
         25       JD   2.572  0.0001
         26       PC   0.000   0.002   0.005   0.008   0.011   0.014   0.017   0.020   0.023   0.026
         27       PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056   0.060
         28       PC   0.064   0.068   0.072   0.076   0.080   0.085   0.090   0.095   0.100   0.105
         29       PC   0.110   0.115   0.120   0.126   0.133   0.140   0.147   0.155   0.163   0.172
         30       PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
         31       PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
         32       PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
         33       PC   0.913   0.918   0.922   0.926   0.930   0.934   0.938   0.942   0.946   0.950
         34       PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977   0.980
         35       PC   0.983   0.986   0.989   0.992   0.995   0.998   1.000
         36       JD   2.443    10.0
         37       JD   2.315    30.0
                  *

         38       KK     L21   BASIN
         39       BA   0.525
         40       LG    0.34    0.25    4.55    0.45      14
         41       UI       0      16      15      16      16      15      41      45      62      70
         42       UI      82      93     101     112     121     131     136     144     143     150
         43       UI     152     150     149     145     141     136     130     115     109     102
         44       UI      91      87      79      73      68      64      59      55      49      46
         45       UI      43      40      35      34      30      30      27      25      24      24
                  *
1                                         HEC-1 INPUT                                             PAGE  2

        LINE      ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

         46       KK  DL21RE  DIVERT
         47       DT    RL21    57.3     0.0
         48       DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
         49       DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
                  *

         50       KK  L21L22   ROUTE
         51       RS       1    FLOW      -1
         52       RC   0.032   0.032   0.032    8793  0.0020    0.00
         53       RX  100.00  101.00  107.00  117.00  169.00  409.00  512.00  513.00
         54       RY  1328.1 1328.00 1326.00 1324.00 1324.10 1326.00 1328.00 1328.10
                  *

         55       KK     L22   BASIN
         56       BA   0.362
         57       LG    0.46    0.25    4.35    0.58       2
         58       UI       0       7       6       7       7       6       7       7       7      14
         59       UI      19      19      24      26      30      32      36      38      40      43
         60       UI      48      47      49      55      55      57      60      60      61      61
         61       UI      64      64      64      64      65      65      62      61      61      60
         62       UI      58      57      54      50      48      46      46      42      39      38
                  *

         63       KK  DL22RE  DIVERT
         64       DT    RL22    15.6     0.0
         65       DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
         66       DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
                  *

         67       KK   CPL22 COMBINE
         68       HC       2   0.887
                  *

         69       KK  L22W01   ROUTE
         70       RS       1    FLOW      -1
         71       RC   0.032   0.032   0.032    3159  0.0063    0.00
         72       RX  100.00  101.00  102.00  115.00  128.00  140.00  141.00  142.00
         73       RY  1320.2 1320.10 1320.00 1314.00 1314.10 1320.00 1320.10 1320.20
                  *

         74       KK     W01   BASIN
         75       BA   0.191
         76       LG    0.50    0.25    3.95    0.40       0
         77       UI       0       9      10       9      24      34      46      55      65      74
         78       UI      82      86      89      89      89      82      77      68      59      52
         79       UI      46      41      35      32      28      24      21      19      17      14
         80       UI      14      10      10      10       7       6       7       6       5       2
         81       UI       2       3       2       2       2       3       2       2       2       2
                  *
1                                         HEC-1 INPUT                                             PAGE  3

        LINE      ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

         82       KK   CPW01 COMBINE
         83       HC       2   1.078
                  *

         84       KK  W01W02   ROUTE
         85       RS       2    FLOW      -1
         86       RC   0.035   0.035   0.035    2650  0.0053    0.00
         87       RX  100.00  111.00  122.00  139.00  162.00  182.00  191.00  200.00
         88       RY  1290.5 1290.25 1290.00 1286.00 1286.10 1290.00 1290.25 1290.50
                  *

         89       KK     W02   BASIN
         90       BA   0.394
         91       LG    0.31    0.25    4.65    0.40      16
         92       UI       0      41      81     192     284     356     393     378     320     238
         93       UI     185     142     107      82      64      45      35      29      21      10
         94       UI      11      10       9      11       0       0       0       0       0       0
         95       UI       0       0       0       0       0       0       0       0       0       0
         96       UI       0       0       0       0       0       0       0       0       0       0
                  *

         97       KK   CPW02 COMBINE
         98       HC       2   1.472
                  *

         99       KK  W02W05   ROUTE
        100       RS       1    FLOW      -1
        101       RC   0.035   0.035   0.035    2214  0.0045    0.00
        102       RX  100.00  106.00  112.00  119.00  135.00  137.00  138.00  141.00
        103       RY  1280.0 1278.00 1277.00 1276.00 1275.90 1277.00 1278.00 1280.00
                  *

        104       KK     W03   BASIN
        105       BA   1.971
        106       LG    0.10    0.25    4.00    0.74      25
        107       UI       0     251     720    1471    1998    2675    1648    1355    1116     875
        108       UI     660     563     428     312     278     192     163     123     123      52
        109       UI      49      48      47      49      48       0       0       0       0       0
        110       UI       0       0       0       0       0       0       0       0       0       0
```

```
111          UI       0       0       0       0       0       0       0       0       0       0
             *

112          KK  W03W04   ROUTE
113          RS       3    FLOW      -1
114          RC   0.035   0.035   0.035   18417  0.0490    0.00
115          RX  100.00  140.00  180.00  210.00  235.00  305.00  345.00  385.00
116          RY  1511.0 1510.50 1510.00 1502.00 1502.10 1510.00 1511.00 1512.00
             *
1                                          HEC-1 INPUT                                          PAGE  4

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

117          KK     W04   BASIN
118          BA   2.034
119          LG    0.14    0.25    4.60    0.50      26
120          UI       0     233     582    1223    1697    2408    2028    1390    1203     990
121          UI     795     619     527     421     317     265     212     181     125     115
122          UI     109      45      45      46      45      44      46       0       0       0
123          UI       0       0       0       0       0       0       0       0       0       0
124          UI       0       0       0       0       0       0       0       0       0       0
             *

125          KK   CPW04 COMBINE
126          HC       2   4.005
             *

127          KK  W04W05   ROUTE
128          RS       3    FLOW      -1
129          RC   0.038   0.038   0.038    5298  0.0098    0.00
130          RX  100.00  120.00  140.00  160.00  174.00  214.00  234.00  254.00
131          RY  1313.0 1312.50 1312.00 1308.00 1308.10 1312.00 1312.50 1313.00
             *

132          KK     W05   BASIN
133          BA   0.316
134          LG    0.26    0.25    4.25    0.47      14
135          UI       0      48     200     294     451     549     367     251     129      72
136          UI      41      15      15      15       0       0       0       0       0       0
137          UI       0       0       0       0       0       0       0       0       0       0
138          UI       0       0       0       0       0       0       0       0       0       0
139          UI       0       0       0       0       0       0       0       0       0       0
             *

140          KK   CPW05 COMBINE
141          HC       3   5.793
             *

142          KK   SRW05 STORAGE
143          KO
144          RS       1    STOR      -1
145          SV                                                  0.70    2.75    8.64   29.89   76.16
146          SQ            87.84  302.83  591.07 1137.58 1394.68 1845.95 2402.27 2963.92 8536.34
147          SE  1258.0 1260.00 1262.00 1264.00 1268.00 1270.00 1272.00 1274.00 1276.00 1278.00
             *

148          KK  W05W12   ROUTE
149          RS       1    FLOW      -1
150          RC   0.025   0.025   0.025    5316  0.0071    0.00
151          RX  100.00  105.00  109.00  125.00  135.00  151.00  155.00  160.00
152          RY  1000.0  999.50  999.00  995.00  995.10  999.00  999.50 1000.00
             *
1                                          HEC-1 INPUT                                          PAGE  5

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

153          KK     W06   BASIN
154          BA   0.707
155          LG    0.10    0.25    4.30    0.64      25
156          UI       0     328    1223    1551     876     569     363     215     139      86
157          UI      43      35      34       0       0       0       0       0       0       0
158          UI       0       0       0       0       0       0       0       0       0       0
159          UI       0       0       0       0       0       0       0       0       0       0
160          UI       0       0       0       0       0       0       0       0       0       0
             *

161          KK     W07   BASIN
162          BA   0.312
163          LG    0.10    0.25    4.25    0.60      96
164          UI       0     306     934     548     303     157      82      44      20      21
165          UI       0       0       0       0       0       0       0       0       0       0
166          UI       0       0       0       0       0       0       0       0       0       0
167          UI       0       0       0       0       0       0       0       0       0       0
168          UI       0       0       0       0       0       0       0       0       0       0
             *

169          KK   CPW07 COMBINE
170          HC       2   1.019
             *

171          KK  W07W08   ROUTE
172          RS       1    FLOW      -1
173          RC   0.032   0.022   0.032    5589  0.0796    0.00
174          RX  100.00  136.00  173.00  197.00  234.00  254.00  298.00  342.00
175          RY  2880.0 2865.00 2850.00 2840.00 2840.00 2850.00 2865.00 2880.00
             *

176          KK     W08   BASIN
177          BA   0.445
178          LG    0.10    0.25    3.95    0.40      25
179          UI       0     496    1400     767     395     198      98      45      32       0
180          UI       0       0       0       0       0       0       0       0       0       0
181          UI       0       0       0       0       0       0       0       0       0       0
182          UI       0       0       0       0       0       0       0       0       0       0
183          UI       0       0       0       0       0       0       0       0       0       0
             *

184          KK   CPW08 COMBINE
185          HC       2   1.464
             *

186          KK     W09   BASIN
187          BA   0.335
188          LG    0.15    0.25    3.95    0.40      64
189          UI       0     394    1068     570     288     141      71      30      24       0
190          UI       0       0       0       0       0       0       0       0       0       0
191          UI       0       0       0       0       0       0       0       0       0       0
192          UI       0       0       0       0       0       0       0       0       0       0
193          UI       0       0       0       0       0       0       0       0       0       0
             *
1                                          HEC-1 INPUT                                          PAGE  6

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

194          KK   CPW09 COMBINE
195          HC       2   1.799
             *

196          KK  W09W10   ROUTE
197          RS       1    FLOW      -1
198          RC   0.035   0.022   0.035   11134  0.0683    0.00
199          RX  100.00  137.00  172.00  192.00  220.00  230.00  284.00  338.00
200          RY  1990.0 1975.00 1960.00 1950.00 1950.00 1960.00 1975.00 1990.00
             *

201          KK     W10   BASIN
202          BA   1.338
203          LG    0.10    0.25    3.95    0.40      25
204          UI       0     395    1548    2646    1783    1282     874     611     394     273
205          UI     184     135      70      52      53      53       0       0       0       0
206          UI       0       0       0       0       0       0       0       0       0       0
207          UI       0       0       0       0       0       0       0       0       0       0
208          UI       0       0       0       0       0       0       0       0       0       0
             *

209          KK   CPW10 COMBINE
210          HC       2   3.137
             *

211          KK     W11   BASIN
212          BA   0.812
213          LG    0.10    0.25    3.95    0.40      25
214          UI       0     275    1046    1697    1048     762     488     340     214     147
215          UI      93      65      34      34      34       0       0       0       0       0
216          UI       0       0       0       0       0       0       0       0       0       0
217          UI       0       0       0       0       0       0       0       0       0       0
218          UI       0       0       0       0       0       0       0       0       0       0
             *

219          KK   CPW11 COMBINE
220          HC       2   3.949
             *

221          KK  W11W12   ROUTE
222          RS       6    FLOW      -1
223          RC   0.035   0.022   0.035   21182  0.0205    0.00
224          RX  100.00  107.00  114.00  125.00  140.00  154.00  244.00  334.00
225          RY  1310.0 1309.00 1308.00 1306.00 1305.90 1308.00 1309.00 1310.00
             *

226          KK     W12   BASIN
227          BA   1.805
228          LG    0.18    0.25    4.60    0.46      14
229          UI       0     176     316     723    1114    1380    1905    1487    1091     947
230          UI     808     705     564     448     406     338     262     222     192     151
231          UI     137     103      85      87      64      34      34      34      34      34
232          UI      33      34       0       0       0       0       0       0       0       0
233          UI       0       0       0       0       0       0       0       0       0       0
             *
1                                          HEC-1 INPUT                                          PAGE  7

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

234          KK   CPW12 COMBINE
235          HC       3  11.547
             *
```

```
236          KK  W12W13   ROUTE
237          RS       1    FLOW      -1
238          RC   0.022   0.022   0.022    2059  0.0121    0.00
239          RX  100.00  107.00  124.00  130.00  159.00  165.00  177.00  183.00
240          RY  1230.0 1228.00 1224.00 1222.00 1221.90 1224.00 1228.00 1230.00
             *

241          KK     W13   BASIN
242          BA   1.584
243          LG    0.21    0.25    4.90    0.36      14
244          UI       0     163     322     742    1082    1371    1809    1158     947     811
245          UI     694     579     443     387     335     252     205     181     140     125
246          UI      91      80      80      46      31      32      31      31      31      32
247          UI      31       0       0       0       0       0       0       0       0       0
248          UI       0       0       0       0       0       0       0       0       0       0
             *

249          KK   CPW13 COMBINE
250          HC       2  13.131
             *

251          KK  W13W16   ROUTE
252          RS       3    FLOW      -1
253          RC   0.035   0.022   0.035    6232  0.0042    0.00
254          RX  100.00  167.00  178.00  189.00  218.00  228.00  239.00  250.00
255          RY  1216.0 1214.00 1212.00 1210.00 1209.90 1212.00 1214.00 1216.00
             *

256          KK     W15   BASIN
257          BA   1.227
258          LG    0.25    0.25    4.55    0.40      24
259          UI       0     140     338     725    1009    1399    1252     848     726     601
260          UI     489     377     321     260     195     162     134     109      82      68
261          UI      70      31      27      27      27      27      27      26       0       0
262          UI       0       0       0       0       0       0       0       0       0       0
263          UI       0       0       0       0       0       0       0       0       0       0
             *

264          KK  DW15RE  DIVERT
265          DT    W15R    91.9     0.0
266          DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
267          DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
             *

268          KK     W14   BASIN
269          BA   1.582
270          LG    0.14    0.25    5.20    0.37      19
271          UI       0     330    1263    2143    2612    1581    1214     868     644     451
272          UI     324     238     167     134      76      52      52      53       0       0
273          UI       0       0       0       0       0       0       0       0       0       0
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

274          UI       0       0       0       0       0       0       0       0       0       0
275          UI       0       0       0       0       0       0       0       0       0       0
             *

276          KK  W14W15   ROUTE
277          RS       1    FLOW      -1
278          RC   0.025   0.025   0.025    7308  0.0104    0.00
279          RX  100.00  105.00  109.00  125.00  135.00  151.00  155.00  160.00
280          RY  1000.0  999.50  999.00  995.00  995.10  999.00  999.50 1000.00
             *

281          KK   CPW15 COMBINE
282          HC       2   2.809
             *

283          KK  W15W16   ROUTE
284          RS       2    FLOW      -1
285          RC   0.035   0.035   0.035    2750  0.0087    0.00
286          RX  100.00  135.00  232.00  328.00  360.00  498.00  635.00  735.00
287          RY  1202.0 1200.00 1199.00 1198.00 1197.90 1199.00 1200.00 1202.00
             *

288          KK     W16   BASIN
289          BA   0.530
290          LG    0.27    0.25    4.55    0.41      21
291          UI       0      67     213     353     466     717     736     529     396     266
292          UI     131      94      58      21      20      21       0       0       0       0
293          UI       0       0       0       0       0       0       0       0       0       0
294          UI       0       0       0       0       0       0       0       0       0       0
295          UI       0       0       0       0       0       0       0       0       0       0
             *

296          KK  DW16RE  DIVERT
297          DT    W16R    39.7     0.0
298          DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
299          DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
             *

300          KK   CPW16 COMBINE
301          HC       3   16.47
             *

302          KK  W16W20   ROUTE
303          RS       1    FLOW      -1
304          RC   0.025   0.025   0.025    3633  0.0130    0.00
305          RX  100.00  105.00  109.00  125.00  135.00  151.00  155.00  160.00
306          RY  1000.0  999.50  999.00  995.00  995.10  999.00  999.50 1000.00
             *

307          KK     W18   BASIN
308          BA   1.260
309          LG    0.24    0.25    4.40    0.44      46
310          UI       0    7025    2342     356       0       0       0       0       0       0
311          UI       0       0       0       0       0       0       0       0       0       0
312          UI       0       0       0       0       0       0       0       0       0       0
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

313          UI       0       0       0       0       0       0       0       0       0       0
314          UI       0       0       0       0       0       0       0       0       0       0
             *

315          KK  DW18RE  DIVERT
316          DT    W18R    94.3     0.0
317          DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
318          DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
             *

319          KK     W17   BASIN
320          BA   1.497
321          LG    0.28    0.25    4.30    0.43      24
322          UI       0     266    1071    1806    2464    1531    1172     893     631     493
323          UI     334     263     187     126     121      49      47      47      47       0
324          UI       0       0       0       0       0       0       0       0       0       0
325          UI       0       0       0       0       0       0       0       0       0       0
326          UI       0       0       0       0       0       0       0       0       0       0
             *

327          KK  W17W18   ROUTE
328          RS       1    FLOW      -1
329          RC   0.045   0.035   0.045    8559  0.0257    0.00
330          RX  100.00  140.00  150.00  156.00  194.00  216.00  255.00  342.00
331          RY  1302.0 1300.00 1298.00 1296.00 1295.90 1298.00 1300.00 1302.00
             *

332          KK   CPW18 COMBINE
333          HC       2   2.757
             *

334          KK  W18W20   ROUTE
335          RS       3    FLOW      -1
336          RC   0.025   0.025   0.025    6914  0.0058    0.00
337          RX  100.00  105.00  109.00  125.00  135.00  151.00  155.00  160.00
338          RY  1000.0  999.50  999.00  995.00  995.10  999.00  999.50 1000.00
             *

339          KK     W19   BASIN
340          BA   1.158
341          LG    0.11    0.25    3.88    0.42      97
342          UI       0     923    3202    2092    1231     701     372     209     106      70
343          UI       0       0       0       0       0       0       0       0       0       0
344          UI       0       0       0       0       0       0       0       0       0       0
345          UI       0       0       0       0       0       0       0       0       0       0
346          UI       0       0       0       0       0       0       0       0       0       0
             *

347          KK  DW19RE  DIVERT
348          DT    RW19    86.7     0.0
349          DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
350          DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
             *
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

351          KK  W19W20   ROUTE
352          RS       1    FLOW      -1
353          RC   0.025   0.025   0.025    3790  0.0158    0.00
354          RX  100.00  105.00  109.00  125.00  135.00  151.00  155.00  160.00
355          RY  1000.0  999.50  999.00  995.00  995.10  999.00  999.50 1000.00
             *

356          KK     W20   BASIN
357          BA   1.137
358          LG    0.26    0.25    4.10    0.54      25
359          UI       0     138     365     765    1050    1503     993     779     662     534
360          UI     409     332     276     203     166     136     105      82      67      65
361          UI      27      26      27      26      27      26       0       0       0       0
362          UI       0       0       0       0       0       0       0       0       0       0
363          UI       0       0       0       0       0       0       0       0       0       0
             *

364          KK  DW20RE  DIVERT
```

```
365          DT    W20R    85.2     0.0
366          DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
367          DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
             *

368          KK   CPW20 COMBINE
369          HC       4  21.522
             *

370          KK   SRW20 STORAGE
371          KM   STAGE-STORAGE-DISCHARGE CURVE FROM URS DESIGN OF FRS#3 OUTLET STRUCTURE
372          KM   THE DISCHARGE INCLUDING OUTFLOW FROM PRINCIPAL AND EMERGENCY SPILLWAY,
373          KM   AS WELL AS INFILTRATION
374          RS       1    STOR      -1
375          SV    44.8     388     585     846    1002    2045    3218    3557    4693    6510
376          SQ    0.02    0.17     4.5     187     203     276     330    2936   24545   70439
377          SE    1188    1198    1200    1202    1203    1208    1212    1213    1216    1220
             *

378          KK   OUTFL
379          KM   SEPRATE OUTFLOW FROM INFILTRATION
             * KO     1
380          ZW   A=WT B=FRS3 C=FLOW
381          DT    INFL
382          DI       0     4.5      86     203     330    2936   24545   70439
383          DQ       0     4.5      10      22      73      79      96     121
384          ZZ
1
              SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
 LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW
  NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

  38         L21
              .
              .
  47          .------->    RL21
  46      DL21RE
              V
              V
  50      L21L22
              .
              .
  55          .        L22
              .          .
              .          .
  64          .          .------->    RL22
  63          .     DL22RE
              .          .
              .          .
  67      CPL22............
              V
              V
  69      L22W01
              .
              .
  74          .        W01
              .          .
              .          .
  82      CPW01............
              V
              V
  84      W01W02
              .
              .
  89          .        W02
              .          .
              .          .
  97      CPW02............
              V
              V
  99      W02W05
              .
              .
 104          .        W03
              .          V
              .          V
 112          .     W03W04
              .          .
              .          .
 117          .          .        W04
              .          .          .
              .          .          .
 125          .      CPW04............
              .          V
              .          V
 127          .     W04W05
              .          .
              .          .
 132          .          .        W05
              .          .          .
              .          .          .
 140      CPW05........................
              V
              V
 142      SRW05
              V
              V
 148      W05W12
              .
              .
 153          .        W06
              .          .
              .          .
 161          .          .        W07
              .          .          .
              .          .          .
 169          .      CPW07............
              .          V
              .          V
 171          .     W07W08
              .          .
              .          .
 176          .          .        W08
              .          .          .
              .          .          .
 184          .      CPW08............
              .          .
              .          .
 186          .          .        W09
              .          .          .
              .          .          .
 194          .      CPW09............
              .          V
              .          V
 196          .     W09W10
              .          .
              .          .
 201          .          .        W10
              .          .          .
              .          .          .
 209          .      CPW10............
              .          .
              .          .
 211          .          .        W11
              .          .          .
              .          .          .
 219          .      CPW11............
              .          V
              .          V
 221          .     W11W12
              .          .
              .          .
 226          .          .        W12
              .          .          .
              .          .          .
 234      CPW12........................
              V
              V
 236      W12W13
              .
              .
 241          .        W13
              .          .
              .          .
 249      CPW13............
              V
              V
 251      W13W16
              .
              .
 256          .        W15
              .          .
              .          .
 265          .          .------->    W15R
 264          .      DW15RE
              .          .
              .          .
 268          .          .        W14
              .          .          V
              .          .          V
 276          .          .     W14W15
              .          .          .
              .          .          .
 281          .      CPW15............
              .          V
              .          V
 283          .      W15W16
              .          .
              .          .
 288          .          .        W16
              .          .          .
              .          .          .
 297          .          .          .------->    W16R
 296          .          .     DW16RE
              .          .          .
              .          .          .
 300      CPW16........................
              V
```

```
                V
302        W16W20
                .
                .
307             .          W18
                .            .
                .            .
316             .            .-------->    W18R
315             .       DW18RE
                .            .
                .            .
319             .            .         W17
                .            .           V
                .            .           V
327             .            .      W17W18
                .            .           .
                .            .           .
332             .        CPW18............
                .            V
                .            V
334             .       W18W20
                .            .
                .            .
339             .            .         W19
                .            .           .
                .            .           .
348             .            .           .-------->    RW19
347             .            .      DW19RE
                .            .           V
                .            .           V
351             .            .      W19W20
                .            .           .
                .            .           .
356             .            .           .         W20
                .            .           .           .
                .            .           .           .
365             .            .           .           .-------->    W20R
364             .            .           .      DW20RE
                .            .           .           .
                .            .           .           .
368        CPW20.................................
                V
                V
370        SRW20
                .
                .
381             .-------->    INFL
378        OUTFL
```

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	L21	80.	13.58	31.	9.	3.	.52		
+	DIVERSION TO	RL21	80.	13.58	31.	9.	3.	.52		
+	HYDROGRAPH AT	DL21RE	0.	.00	0.	0.	0.	.52		
+	ROUTED TO	L21L22	0.	.00	0.	0.	0.	.52		
+	HYDROGRAPH AT	L22	21.	14.75	10.	2.	1.	.36		
+	DIVERSION TO	RL22	21.	14.75	10.	2.	1.	.36		
+	HYDROGRAPH AT	DL22RE	0.	.00	0.	0.	0.	.36		
+	2 COMBINED AT	CPL22	0.	.00	0.	0.	0.	.89		
+	ROUTED TO	L22W01	0.	.00	0.	0.	0.	.89		
+	HYDROGRAPH AT	W01	37.	13.00	9.	2.	1.	.19		
+	2 COMBINED AT	CPW01	37.	13.00	8.	2.	1.	1.08		
+	ROUTED TO	W01W02	35.	13.25	8.	2.	1.	1.08		
+	HYDROGRAPH AT	W02	193.	12.42	27.	8.	3.	.39		
+	2 COMBINED AT	CPW02	194.	12.42	35.	10.	3.	1.47		
+	ROUTED TO	W02W05	179.	12.58	35.	10.	3.	1.47		
+	HYDROGRAPH AT	W03	965.	12.33	142.	45.	15.	1.97		
+	ROUTED TO	W03W04	729.	12.67	142.	45.	15.	1.97		
+	HYDROGRAPH AT	W04	1086.	12.33	164.	51.	17.	2.03		
+	2 COMBINED AT	CPW04	1497.	12.42	304.	95.	32.	4.01		
+	ROUTED TO	W04W05	1432.	12.58	304.	95.	32.	4.01		
+	HYDROGRAPH AT	W05	216.	12.33	21.	6.	2.	.32		
+	3 COMBINED AT	CPW05	1681.	12.58	358.	111.	37.	5.79		
+	ROUTED TO	SRW05	1655.	12.67	358.	111.	37.	5.79		
+	ROUTED TO	W05W12	1593.	12.75	358.	111.	37.	5.79		
+	HYDROGRAPH AT	W06	561.	12.17	53.	17.	6.	.71		
+	HYDROGRAPH AT	W07	447.	12.08	57.	20.	7.	.31		
+	2 COMBINED AT	CPW07	992.	12.17	110.	37.	12.	1.02		
+	ROUTED TO	W07W08	934.	12.17	110.	37.	12.	1.02		
+	HYDROGRAPH AT	W08	490.	12.08	39.	12.	4.	.44		
+	2 COMBINED AT	CPW08	1397.	12.17	148.	48.	16.	1.46		
+	HYDROGRAPH AT	W09	442.	12.08	47.	16.	5.	.34		
+	2 COMBINED AT	CPW09	1807.	12.17	194.	64.	21.	1.80		
+	ROUTED TO	W09W10	1512.	12.25	194.	64.	21.	1.80		
+	HYDROGRAPH AT	W10	1133.	12.17	116.	35.	12.	1.34		
+	2 COMBINED AT	CPW10	2578.	12.25	309.	99.	33.	3.14		
+	HYDROGRAPH AT	W11	716.	12.17	71.	22.	7.	.81		
+	2 COMBINED AT	CPW11	3247.	12.17	379.	120.	40.	3.95		
+	ROUTED TO	W11W12	2332.	12.67	378.	120.	40.	3.95		
+	HYDROGRAPH AT	W12	778.	12.42	117.	34.	11.	1.80		
+	3 COMBINED AT	CPW12	4296.	12.67	838.	261.	87.	11.55		
+	ROUTED TO	W12W13	4269.	12.67	838.	261.	87.	11.55		
+	HYDROGRAPH AT	W13	762.	12.42	109.	32.	11.	1.58		
+	2 COMBINED AT	CPW13	4666.	12.67	936.	289.	97.	13.13		
+	ROUTED TO	W13W16	4547.	12.83	936.	289.	97.	13.13		

```
+     HYDROGRAPH AT
                W15     674.  12.33     100.     31.     10.    1.23
+     DIVERSION TO
               W15R     674.  12.33     100.     31.     10.    1.23
+     HYDROGRAPH AT
             DW15RE       0.    .00       0.      0.      0.    1.23
+     HYDROGRAPH AT
                W14    1120.  12.25     119.     36.     12.    1.58
+     ROUTED TO
            W14W15     876.  12.33     119.     35.     12.    1.58
+     2 COMBINED AT
              CPW15     871.  12.33     119.     35.     12.    2.81
+     ROUTED TO
            W15W16     758.  12.50     119.     35.     12.    2.81
+     HYDROGRAPH AT
                W16     347.  12.42      41.     12.      4.     .53
+     DIVERSION TO
               W16R     347.  12.42      41.     12.      4.     .53
+     HYDROGRAPH AT
             DW16RE       0.    .00       0.      0.      0.     .53
+     3 COMBINED AT
              CPW16    4956.  12.83    1034.    318.    107.   16.47
+     ROUTED TO
            W16W20    4940.  12.83    1034.    318.    107.   16.47
+     HYDROGRAPH AT
                W18    1778.  12.08     140.     46.     15.    1.26
+     DIVERSION TO
               W18R    1778.  12.08     140.     46.     15.    1.26
+     HYDROGRAPH AT
             DW18RE       2.  22.42       1.      0.      0.    1.26
+     HYDROGRAPH AT
                W17    1020.  12.25     119.     37.     12.    1.50
+     ROUTED TO
            W17W18     735.  12.42     119.     37.     12.    1.50
+     2 COMBINED AT
              CPW18     732.  12.42     118.     37.     12.    2.76
+     ROUTED TO
            W18W20     656.  12.58     118.     36.     12.    2.76
+     HYDROGRAPH AT
                W19    1610.  12.17     212.     74.     25.    1.16
+     DIVERSION TO
               RW19    1597.  12.08     151.     44.     15.    1.16
+     HYDROGRAPH AT
             DW19RE     768.  12.33      99.     31.     10.    1.16
+     ROUTED TO
            W19W20     624.  12.42      98.     31.     10.    1.16
+     HYDROGRAPH AT
                W20     603.  12.33      88.     28.      9.    1.14
+     DIVERSION TO
               W20R     603.  12.33      88.     28.      9.    1.14
+     HYDROGRAPH AT
             DW20RE       0.    .00       0.      0.      0.    1.14
+     4 COMBINED AT
              CPW20    5555.  12.83    1203.    374.    125.   21.52
+     ROUTED TO
              SRW20      91.  22.17      91.     74.     35.   21.52
+     DIVERSION TO
               INFL      11.  21.75      11.      9.      7.   21.52
+     HYDROGRAPH AT
               OUTFL      81.  22.17      80.     64.     28.   21.52

*** NORMAL END OF HEC-1 ***
```

A.7 FUTURE CONDITIONS 100-YEAR FOR FRS#3 MAJOR BASIN

```
1****************************************          **************************************
 *                                      *          *                                    *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *          *   U.S. ARMY CORPS OF ENGINEERS     *
 *             JUN   1998               *          *   HYDROLOGIC ENGINEERING CENTER    *
 *           VERSION 4.1                *          *         609 SECOND STREET          *
 *                                      *          *      DAVIS, CALIFORNIA 95616       *
 *  RUN DATE   27MAR09  TIME  10:22:54  *          *         (916) 756-1104             *
 *                                      *          *                                    *
 ****************************************          **************************************


                    X      X  XXXXXXX   XXXXX            X
                    X      X  X        X     X          XX
                    X      X  X        X                 X
                    XXXXXXX   XXXX     X         XXXXX   X
                    X      X  X        X                 X
                    X      X  X        X     X           X
                    X      X  XXXXXXX   XXXXX           XXX


    THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

    THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
    THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
    NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
    DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
    KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                       HEC-1 INPUT                                      PAGE  1

 LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

   1          ID           WHITE TANKS AREA, WATERSHED CONTRIBUTING TO FRS#3
   2          ID           PREPARED BY HOSKIN RYAN CONSULTANTS EXCLUSIVELY FOR
   3          ID           FRS#3 OUTLET CHANNEL DESIGN, 03-17-2009
   4          ID           BASED ON HDR HEC-1 MODEL OF FUTURE CONDITION WITH CIP
   5          ID           MODIFICATIONS INCLUDE:
   6          ID           (1) UPDATE WITH AVERAGE RAINFALL DEPTH FOR FRS#3 WATERSHED ONLY
   7          ID           (2) UPDATE THE STAGE-STORAGE-DISCHARGE CURVE BASED ON URS DESIGN
   8          ID               OF FRS#3 PRINCIPAL AND EMERGENCY SPILLWAY (DISCHARGE
   9          ID               INCLUDING INFILTRATION)
  10          ID           (3) SEPARATE FRS#3 OUTFLOW AND INFILTRATION
  11          ID       ****************************************************************
  12          ID         Flood Control District of Maricopa County
  13          ID         FU_CIP_MB02 - Loop 303/ White Tanks ADMPU AHA
  14          ID         Major Basin: 02
  15          ID         100 Year - Return Period
  16          ID         24 Hour Storm
  17          ID         Multiple Storms
  18          ID         Unit Hydrograph: S-Graph
  19          ID         03/08/2009
  20          IT       5  1JAN99    1200    2000
  21          IN      15
  22          IO       5
              *DIAGRAM
              *
  23          JD   4.016  0.0001
  24          PC   0.000   0.002   0.005   0.008   0.011   0.014   0.017   0.020   0.023   0.026
  25          PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056   0.060
  26          PC   0.064   0.068   0.072   0.076   0.080   0.085   0.090   0.095   0.100   0.105
  27          PC   0.110   0.115   0.120   0.126   0.133   0.140   0.147   0.155   0.163   0.172
  28          PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
  29          PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
  30          PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
  31          PC   0.913   0.918   0.922   0.926   0.930   0.934   0.938   0.942   0.946   0.950
  32          PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977   0.980
  33          PC   0.983   0.986   0.989   0.992   0.995   0.998   1.000
  34          JD   3.815    10.0
  35          JD   3.614    30.0
              *

  36          KK     L21   BASIN
  37          BA   0.525
  38          LG    0.34    0.25    4.55    0.45      14
  39          UI       0      16      15      16      16      15      41      45      62      70
  40          UI      82      93     101     112     121     131     136     144     143     150
  41          UI     152     150     149     145     141     136     130     115     109     102
  42          UI      91      87      79      73      68      64      59      55      49      46
  43          UI      43      40      35      34      30      30      27      25      24      24
              *

  44          KK  DL21RE  DIVERT
  45          DT    RL21    57.3     0.0
  46          DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
  47          DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
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              *
1                                       HEC-1 INPUT                                      PAGE  2

 LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  48          KK  L21L22   ROUTE
  49          RS       1    FLOW      -1
  50          RC   0.032   0.032   0.032    8793  0.0020    0.00
  51          RX  100.00  101.00  107.00  117.00  169.00  409.00  512.00  513.00
  52          RY  1328.1 1328.00 1326.00 1324.00 1324.10 1326.00 1328.00 1328.10
              *

  53          KK     L22   BASIN
  54          BA   0.362
  55          LG    0.46    0.25    4.35    0.58       2
  56          UI       0       7       6       7       7       6       7       7       7      14
  57          UI      19      19      24      26      30      32      36      38      40      43
  58          UI      48      47      49      55      55      57      60      60      61      61
  59          UI      64      64      64      64      65      65      62      61      61      60
  60          UI      58      57      54      50      48      46      46      42      39      38
              *

  61          KK  DL22RE  DIVERT
  62          DT    RL22    15.6     0.0
  63          DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
  64          DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
              *

  65          KK   CPL22 COMBINE
  66          HC       2   0.887
              *

  67          KK  L22W01   ROUTE
  68          RS       1    FLOW      -1
  69          RC   0.032   0.032   0.032    3159  0.0063    0.00
  70          RX  100.00  101.00  102.00  115.00  128.00  140.00  141.00  142.00
  71          RY  1320.2 1320.10 1320.00 1314.00 1314.10 1320.00 1320.10 1320.20
              *

  72          KK     W01   BASIN
  73          BA   0.191
  74          LG    0.50    0.25    3.95    0.40       0
  75          UI       0       9      10       9      24      34      46      55      65      74
  76          UI      82      86      89      89      89      82      77      68      59      52
  77          UI      46      41      35      32      28      24      21      19      17      14
  78          UI      14      10      10      10       7       6       7       6       5       2
  79          UI       2       3       2       2       2       3       2       2       2       2
              *

  80          KK   CPW01 COMBINE
  81          HC       2   1.078
              *

  82          KK  W01W02   ROUTE
  83          RS       2    FLOW      -1
  84          RC   0.035   0.035   0.035    2650  0.0053    0.00
  85          RX  100.00  111.00  122.00  139.00  162.00  182.00  191.00  200.00
  86          RY  1290.5 1290.25 1290.00 1286.00 1286.10 1290.00 1290.25 1290.50
              *
1                                       HEC-1 INPUT                                      PAGE  3

 LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  87          KK     W02   BASIN
  88          BA   0.394
  89          LG    0.31    0.25    4.65    0.40      16
  90          UI       0      41      81     192     284     356     393     378     320     238
  91          UI     185     142     107      82      64      45      35      29      21      10
  92          UI      11      10       9      11       0       0       0       0       0       0
  93          UI       0       0       0       0       0       0       0       0       0       0
  94          UI       0       0       0       0       0       0       0       0       0       0
              *

  95          KK   CPW02 COMBINE
  96          HC       2   1.472
              *

  97          KK  W02W05   ROUTE
  98          RS       1    FLOW      -1
  99          RC   0.035   0.035   0.035    2214  0.0045    0.00
 100          RX  100.00  106.00  112.00  119.00  135.00  137.00  138.00  141.00
 101          RY  1280.0 1278.00 1277.00 1276.00 1275.90 1277.00 1278.00 1280.00
              *

 102          KK     W03   BASIN
 103          BA   1.971
 104          LG    0.10    0.25    4.00    0.74      25
 105          UI       0     251     720    1471    1998    2675    1648    1355    1116     875
 106          UI     660     563     428     312     278     192     163     123     123      52
 107          UI      49      48      47      49      48       0       0       0       0       0
 108          UI       0       0       0       0       0       0       0       0       0       0
 109          UI       0       0       0       0       0       0       0       0       0       0
              *
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110          KK  W03W04   ROUTE
111          RS       3    FLOW      -1
112          RC   0.035   0.035   0.035   18417  0.0490    0.00
113          RX  100.00  140.00  180.00  210.00  235.00  305.00  345.00  385.00
114          RY  1511.0 1510.50 1510.00 1502.00 1502.10 1510.00 1511.00 1512.00
             *

115          KK     W04   BASIN
116          BA   2.034
117          LG    0.14    0.25    4.60    0.50      26
118          UI       0     233     582    1223    1697    2408    2028    1390    1203     990
119          UI     795     619     527     421     317     265     212     181     125     115
120          UI     109      45      45      46      45      44      46       0       0       0
121          UI       0       0       0       0       0       0       0       0       0       0
122          UI       0       0       0       0       0       0       0       0       0       0
             *

123          KK   CPW04 COMBINE
124          HC       2   4.005
             *
1                                        HEC-1 INPUT                                          PAGE  4

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

125          KK  W04W05   ROUTE
126          RS       3    FLOW      -1
127          RC   0.038   0.038   0.038    5298  0.0098    0.00
128          RX  100.00  120.00  140.00  160.00  174.00  214.00  234.00  254.00
129          RY  1313.0 1312.50 1312.00 1308.00 1308.10 1312.00 1312.50 1313.00
             *

130          KK     W05   BASIN
131          BA   0.316
132          LG    0.26    0.25    4.25    0.47      14
133          UI       0      48     200     294     451     549     367     251     129      72
134          UI      41      15      15      15       0       0       0       0       0       0
135          UI       0       0       0       0       0       0       0       0       0       0
136          UI       0       0       0       0       0       0       0       0       0       0
137          UI       0       0       0       0       0       0       0       0       0       0
             *

138          KK   CPW05 COMBINE
139          HC       3   5.793
             *

140          KK   SRW05 STORAGE
141          KO
142          RS       1    STOR      -1
143          SV                                          0.70    2.75    8.64   29.89   76.16
144          SQ           87.84  302.83  591.07 1137.58 1394.68 1845.95 2402.27 2963.92 8536.34
145          SE  1258.0 1260.00 1262.00 1264.00 1268.00 1270.00 1272.00 1274.00 1276.00 1278.00
             *

146          KK  W05W12   ROUTE
147          RS       1    FLOW      -1
148          RC   0.025   0.025   0.025    5316  0.0071    0.00
149          RX  100.00  105.00  109.00  125.00  135.00  151.00  155.00  160.00
150          RY  1000.0  999.50  999.00  995.00  995.10  999.00  999.50 1000.00
             *

151          KK     W06   BASIN
152          BA   0.707
153          LG    0.10    0.25    4.30    0.64      25
154          UI       0     328    1223    1551     876     569     363     215     139      86
155          UI      43      35      34       0       0       0       0       0       0       0
156          UI       0       0       0       0       0       0       0       0       0       0
157          UI       0       0       0       0       0       0       0       0       0       0
158          UI       0       0       0       0       0       0       0       0       0       0
             *

159          KK     W07   BASIN
160          BA   0.312
161          LG    0.10    0.25    4.25    0.60      96
162          UI       0     306     934     548     303     157      82      44      20      21
163          UI       0       0       0       0       0       0       0       0       0       0
164          UI       0       0       0       0       0       0       0       0       0       0
165          UI       0       0       0       0       0       0       0       0       0       0
166          UI       0       0       0       0       0       0       0       0       0       0
             *
1                                        HEC-1 INPUT                                          PAGE  5

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

167          KK   CPW07 COMBINE
168          HC       2   1.019
             *

169          KK  W07W08   ROUTE
170          RS       1    FLOW      -1
171          RC   0.032   0.022   0.032    5589  0.0796    0.00
172          RX  100.00  136.00  173.00  197.00  234.00  254.00  298.00  342.00
173          RY  2880.0 2865.00 2850.00 2840.00 2840.00 2850.00 2865.00 2880.00
             *

174          KK     W08   BASIN
175          BA   0.445
176          LG    0.10    0.25    3.95    0.40      25
177          UI       0     496    1400     767     395     198      98      45      32       0
178          UI       0       0       0       0       0       0       0       0       0       0
179          UI       0       0       0       0       0       0       0       0       0       0
180          UI       0       0       0       0       0       0       0       0       0       0
181          UI       0       0       0       0       0       0       0       0       0       0
             *

182          KK   CPW08 COMBINE
183          HC       2   1.464
             *

184          KK     W09   BASIN
185          BA   0.335
186          LG    0.15    0.25    3.95    0.40      64
187          UI       0     394    1068     570     288     141      71      30      24       0
188          UI       0       0       0       0       0       0       0       0       0       0
189          UI       0       0       0       0       0       0       0       0       0       0
190          UI       0       0       0       0       0       0       0       0       0       0
191          UI       0       0       0       0       0       0       0       0       0       0
             *

192          KK   CPW09 COMBINE
193          HC       2   1.799
             *

194          KK  W09W10   ROUTE
195          RS       1    FLOW      -1
196          RC   0.035   0.022   0.035   11134  0.0683    0.00
197          RX  100.00  137.00  172.00  192.00  220.00  230.00  284.00  338.00
198          RY  1990.0 1975.00 1960.00 1950.00 1950.00 1960.00 1975.00 1990.00
             *

199          KK     W10   BASIN
200          BA   1.338
201          LG    0.10    0.25    3.95    0.40      25
202          UI       0     395    1548    2646    1783    1282     874     611     394     273
203          UI     184     135      70      52      53      53       0       0       0       0
204          UI       0       0       0       0       0       0       0       0       0       0
205          UI       0       0       0       0       0       0       0       0       0       0
206          UI       0       0       0       0       0       0       0       0       0       0
             *
1                                        HEC-1 INPUT                                          PAGE  6

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

207          KK   CPW10 COMBINE
208          HC       2   3.137
             *

209          KK     W11   BASIN
210          BA   0.812
211          LG    0.10    0.25    3.95    0.40      25
212          UI       0     275    1046    1697    1048     762     488     340     214     147
213          UI      93      65      34      34      34       0       0       0       0       0
214          UI       0       0       0       0       0       0       0       0       0       0
215          UI       0       0       0       0       0       0       0       0       0       0
216          UI       0       0       0       0       0       0       0       0       0       0
             *

217          KK   CPW11 COMBINE
218          HC       2   3.949
             *

219          KK  W11W12   ROUTE
220          RS       6    FLOW      -1
221          RC   0.035   0.022   0.035   21182  0.0205    0.00
222          RX  100.00  107.00  114.00  125.00  140.00  154.00  244.00  334.00
223          RY  1310.0 1309.00 1308.00 1306.00 1305.90 1308.00 1309.00 1310.00
             *

224          KK     W12   BASIN
225          BA   1.805
226          LG    0.18    0.25    4.60    0.46      14
227          UI       0     176     316     723    1114    1380    1905    1487    1091     947
228          UI     808     705     564     448     406     338     262     222     192     151
229          UI     137     103      85      87      64      34      34      34      34      34
230          UI      33      34       0       0       0       0       0       0       0       0
231          UI       0       0       0       0       0       0       0       0       0       0
             *

232          KK   CPW12 COMBINE
233          HC       3  11.547
             *

234          KK  W12W13   ROUTE
235          RS       1    FLOW      -1
236          RC   0.022   0.022   0.022    2059  0.0121    0.00
237          RX  100.00  107.00  124.00  130.00  159.00  165.00  177.00  183.00
238          RY  1230.0 1228.00 1224.00 1222.00 1221.90 1224.00 1228.00 1230.00
```

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                 *
 239             KK     W13   BASIN
 240             BA   1.584
 241             LG    0.21    0.25    4.90    0.36      14
 242             UI       0     163     322     742    1082    1371    1809    1158     947     811
 243             UI     694     579     443     387     335     252     205     181     140     125
 244             UI      91      80      80      46      31      32      31      31      31      32
 245             UI      31       0       0       0       0       0       0       0       0       0
 246             UI       0       0       0       0       0       0       0       0       0       0
                 *
1                                          HEC-1 INPUT                                          PAGE  7
LINE             ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 247             KK   CPW13 COMBINE
 248             HC       2  13.131
                 *
 249             KK  W13W16   ROUTE
 250             RS       3    FLOW      -1
 251             RC   0.035   0.022   0.035    6232  0.0042    0.00
 252             RX  100.00  167.00  178.00  189.00  218.00  228.00  239.00  250.00
 253             RY  1216.0 1214.00 1212.00 1210.00 1209.90 1212.00 1214.00 1216.00
                 *
 254             KK     W15   BASIN
 255             BA   1.227
 256             LG    0.25    0.25    4.55    0.40      24
 257             UI       0     140     338     725    1009    1399    1252     848     726     601
 258             UI     489     377     321     260     195     162     134     109      82      68
 259             UI      70      31      27      27      27      27      27      26       0       0
 260             UI       0       0       0       0       0       0       0       0       0       0
 261             UI       0       0       0       0       0       0       0       0       0       0
                 *
 262             KK  DW15RE  DIVERT
 263             DT    W15R    91.9     0.0
 264             DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
 265             DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
                 *
 266             KK     W14   BASIN
 267             BA   1.582
 268             LG    0.14    0.25    5.20    0.37      19
 269             UI       0     330    1263    2143    2612    1581    1214     868     644     451
 270             UI     324     238     167     134      76      52      52      53       0       0
 271             UI       0       0       0       0       0       0       0       0       0       0
 272             UI       0       0       0       0       0       0       0       0       0       0
 273             UI       0       0       0       0       0       0       0       0       0       0
                 *
 274             KK  W14W15   ROUTE
 275             RS       1    FLOW      -1
 276             RC   0.025   0.025   0.025    7308  0.0104    0.00
 277             RX  100.00  105.00  109.00  125.00  135.00  151.00  155.00  160.00
 278             RY  1000.0  999.50  999.00  995.00  995.10  999.00  999.50 1000.00
                 *
 279             KK   CPW15 COMBINE
 280             HC       2   2.809
                 *
 281             KK  W15W16   ROUTE
 282             RS       2    FLOW      -1
 283             RC   0.035   0.035   0.035    2750  0.0087    0.00
 284             RX  100.00  135.00  232.00  328.00  360.00  498.00  635.00  735.00
 285             RY  1202.0 1200.00 1199.00 1198.00 1197.90 1199.00 1200.00 1202.00
                 *
1                                          HEC-1 INPUT                                          PAGE  8
LINE             ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 286             KK     W16   BASIN
 287             BA   0.530
 288             LG    0.27    0.25    4.55    0.41      21
 289             UI       0      67     213     353     466     717     736     529     396     266
 290             UI     131      94      58      21      20      21       0       0       0       0
 291             UI       0       0       0       0       0       0       0       0       0       0
 292             UI       0       0       0       0       0       0       0       0       0       0
 293             UI       0       0       0       0       0       0       0       0       0       0
                 *
 294             KK  DW16RE  DIVERT
 295             DT    W16R    39.7     0.0
 296             DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
 297             DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
                 *
 298             KK   CPW16 COMBINE
 299             HC       3   16.47
                 *
 300             KK  W16W20   ROUTE
 301             RS       1    FLOW      -1
 302             RC   0.025   0.025   0.025    3633  0.0130    0.00
 303             RX  100.00  105.00  109.00  125.00  135.00  151.00  155.00  160.00
 304             RY  1000.0  999.50  999.00  995.00  995.10  999.00  999.50 1000.00
                 *
 305             KK     W18   BASIN
 306             BA   1.260
 307             LG    0.24    0.25    4.40    0.44      46
 308             UI       0    7025    2342     356       0       0       0       0       0       0
 309             UI       0       0       0       0       0       0       0       0       0       0
 310             UI       0       0       0       0       0       0       0       0       0       0
 311             UI       0       0       0       0       0       0       0       0       0       0
 312             UI       0       0       0       0       0       0       0       0       0       0
                 *
 313             KK  DW18RE  DIVERT
 314             DT    W18R    94.3     0.0
 315             DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
 316             DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
                 *
 317             KK     W17   BASIN
 318             BA   1.497
 319             LG    0.28    0.25    4.30    0.43      24
 320             UI       0     266    1071    1806    2464    1531    1172     893     631     493
 321             UI     334     263     187     126     121      49      47      47      47       0
 322             UI       0       0       0       0       0       0       0       0       0       0
 323             UI       0       0       0       0       0       0       0       0       0       0
 324             UI       0       0       0       0       0       0       0       0       0       0
                 *
1                                          HEC-1 INPUT                                          PAGE  9
LINE             ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 325             KK  W17W18   ROUTE
 326             RS       1    FLOW      -1
 327             RC   0.045   0.035   0.045    8559  0.0257    0.00
 328             RX  100.00  140.00  150.00  156.00  194.00  216.00  255.00  342.00
 329             RY  1302.0 1300.00 1298.00 1296.00 1295.90 1298.00 1300.00 1302.00
                 *
 330             KK   CPW18 COMBINE
 331             HC       2   2.757
                 *
 332             KK  W18W20   ROUTE
 333             RS       3    FLOW      -1
 334             RC   0.025   0.025   0.025    6914  0.0058    0.00
 335             RX  100.00  105.00  109.00  125.00  135.00  151.00  155.00  160.00
 336             RY  1000.0  999.50  999.00  995.00  995.10  999.00  999.50 1000.00
                 *
 337             KK     W19   BASIN
 338             BA   1.158
 339             LG    0.11    0.25    3.88    0.42      97
 340             UI       0     923    3202    2092    1231     701     372     209     106      70
 341             UI       0       0       0       0       0       0       0       0       0       0
 342             UI       0       0       0       0       0       0       0       0       0       0
 343             UI       0       0       0       0       0       0       0       0       0       0
 344             UI       0       0       0       0       0       0       0       0       0       0
                 *
 345             KK  DW19RE  DIVERT
 346             DT    RW19    86.7     0.0
 347             DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
 348             DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
                 *
 349             KK  W19W20   ROUTE
 350             RS       1    FLOW      -1
 351             RC   0.025   0.025   0.025    3790  0.0158    0.00
 352             RX  100.00  105.00  109.00  125.00  135.00  151.00  155.00  160.00
 353             RY  1000.0  999.50  999.00  995.00  995.10  999.00  999.50 1000.00
                 *
 354             KK     W20   BASIN
 355             BA   1.137
 356             LG    0.26    0.25    4.10    0.54      25
 357             UI       0     138     365     765    1050    1503     993     779     662     534
 358             UI     409     332     276     203     166     136     105      82      67      65
 359             UI      27      26      27      26      27      26       0       0       0       0
 360             UI       0       0       0       0       0       0       0       0       0       0
 361             UI       0       0       0       0       0       0       0       0       0       0
                 *
1                                          HEC-1 INPUT                                          PAGE 10
LINE             ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 362             KK  DW20RE  DIVERT
 363             DT    W20R    85.2     0.0
 364             DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
```

```
365          DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
             *

366          KK   CPW20 COMBINE
367          HC       4  21.522
             *

368          KK   SRW20 STORAGE
369          KM   STAGE-STORAGE-DISCHARGE CURVE FROM URS DESIGN OF FRS#3 OUTLET STRUCTURE
370          KM   THE DISCHARGE INCLUDING OUTFLOW FROM PRINCIPAL AND EMERGENCY SPILLWAY,
371          KM   AS WELL AS INFILTRATION
372          RS      1   STOR      -1
373          SV    44.8     388     585     846    1002    2045    3218    3557    4693    6510
374          SQ    0.02    0.17     4.5     187     203     276     330    2936   24545   70439
375          SE    1188    1198    1200    1202    1203    1208    1212    1213    1216    1220
             *

376          KK   OUTFL
377          KM   SEPRATE OUTFLOW FROM INFILTRATION
             * KO     1
378          ZW   A=WT B=FRS3 C=FLOW
379          DT    INFL
380          DI       0     4.5      86     203     330    2936   24545   70439
381          DQ       0     4.5      10      22      73      79      96     121
382          ZZ
1
          SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE     (V) ROUTING          (--->) DIVERSION OR PUMP FLOW
   NO.     (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

    36       L21
               .
               .
    45         .------->    RL21
    44     DL21RE
               V
               V
    48     L21L22
               .
               .
    53         .        L22
               .          .
               .          .
    62         .          .------->    RL22
    61         .     DL22RE
               .          .
               .          .
    65     CPL22............
               V
               V
    67     L22W01
               .
               .
    72         .        W01
               .          .
               .          .
    80     CPW01............
               V
               V
    82     W01W02
               .
               .
    87         .        W02
               .          .
               .          .
    95     CPW02............
               V
               V
    97     W02W05
               .
               .
   102         .        W03
               .          V
               .          V
   110         .     W03W04
               .          .
               .          .
   115         .          .        W04
               .          .          .
               .          .          .
   123         .     CPW04............
               .          V
               .          V
   125         .     W04W05
               .          .
               .          .
   130         .          .        W05
               .          .          .
               .          .          .
   138     CPW05........................
               V
               V
   140     SRW05
               V
               V
   146     W05W12
               .
               .
   151         .        W06
               .          .
               .          .
   159         .          .        W07
               .          .          .
               .          .          .
   167         .     CPW07............
               .          V
               .          V
   169         .     W07W08
               .          .
               .          .
   174         .          .        W08
               .          .          .
               .          .          .
   182         .     CPW08............
               .          .
               .          .
   184         .          .        W09
               .          .          .
               .          .          .
   192         .     CPW09............
               .          V
               .          V
   194         .     W09W10
               .          .
               .          .
   199         .          .        W10
               .          .          .
               .          .          .
   207         .     CPW10............
               .          .
               .          .
   209         .          .        W11
               .          .          .
               .          .          .
   217         .     CPW11............
               .          V
               .          V
   219         .     W11W12
               .          .
               .          .
   224         .          .        W12
               .          .          .
               .          .          .
   232     CPW12........................
               V
               V
   234     W12W13
               .
               .
   239         .        W13
               .          .
               .          .
   247     CPW13............
               V
               V
   249     W13W16
               .
               .
   254         .        W15
               .          .
               .          .
   263         .          .------->    W15R
   262         .     DW15RE
               .          .
               .          .
   266         .          .        W14
               .          .          V
               .          .          V
   274         .          .     W14W15
               .          .          .
               .          .          .
   279         .     CPW15............
               .          V
               .          V
   281         .     W15W16
               .          .
               .          .
   286         .          .        W16
               .          .          .
               .          .          .
   295         .          .          .------->    W16R
   294         .          .     DW16RE
               .          .          .
               .          .          .
   298     CPW16........................
               V
               V
   300     W16W20
```

```
                DIVERSION TO
+                       W15R     1315.  12.33       174.       46.       15.     1.23
                HYDROGRAPH AT
+                      DW15RE      173.  13.33        32.       10.        3.     1.23
                HYDROGRAPH AT
+                        W14     2159.  12.25       234.       68.       23.     1.58
                ROUTED TO
+                     W14W15     1878.  12.33       234.       67.       23.     1.58
                2 COMBINED AT
+                      CPW15     1871.  12.33       258.       77.       26.     2.81
                ROUTED TO
+                     W15W16     1676.  12.50       258.       77.       26.     2.81
                HYDROGRAPH AT
+                        W16      678.  12.33        79.       23.        8.      .53
                DIVERSION TO
+                       W16R      678.  12.33        76.       20.        7.      .53
                HYDROGRAPH AT
+                      DW16RE       33.  12.83         9.        3.        1.      .53
                3 COMBINED AT
+                      CPW16     9419.  12.75      2007.      600.      201.    16.47
                ROUTED TO
+                     W16W20     9326.  12.83      2007.      600.      201.    16.47
                HYDROGRAPH AT
+                        W18     3082.  12.08       244.       78.       26.     1.26
                DIVERSION TO
+                       W18R     2993.  12.00       171.       48.       16.     1.26
                HYDROGRAPH AT
+                      DW18RE     2095.  12.08       104.       31.       10.     1.26
                HYDROGRAPH AT
+                        W17     1981.  12.25       229.       68.       23.     1.50
                ROUTED TO
+                     W17W18     1587.  12.33       229.       68.       23.     1.50
                2 COMBINED AT
+                      CPW18     2589.  12.08       326.       98.       33.     2.76
                ROUTED TO
+                     W18W20     1903.  12.33       325.       98.       33.     2.76
                HYDROGRAPH AT
+                        W19     2526.  12.17       332.      116.       39.     1.16
                DIVERSION TO
+                       RW19     1230.  11.92       139.       44.       15.     1.16
                HYDROGRAPH AT
+                      DW19RE     2526.  12.17       252.       73.       24.     1.16
                ROUTED TO
+                     W19W20     2452.  12.17       251.       73.       24.     1.16
                HYDROGRAPH AT
+                        W20     1197.  12.33       169.       51.       17.     1.14
                DIVERSION TO
+                       W20R     1197.  12.33       160.       43.       14.     1.14
                HYDROGRAPH AT
+                      DW20RE       76.  13.67        23.        8.        3.     1.14
                4 COMBINED AT
+                      CPW20    10703.  12.75      2492.      751.      251.    21.52
                ROUTED TO
+                      SRW20      226.  20.08       225.      220.      155.    21.52
                DIVERSION TO
+                       INFL       31.  20.17        31.       29.       19.    21.52
                HYDROGRAPH AT
+                      OUTFL      195.  20.08       194.      191.      135.    21.52

*** NORMAL END OF HEC-1 ***
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A.8 EXISTING CONDITIONS 10-YEAR FOR FRS#3 MAJOR BASIN

```
1***************************************        ***************************************
 *                                     *        *                                     *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1) *        *   U.S. ARMY CORPS OF ENGINEERS      *
 *              JUN   1998             *        *   HYDROLOGIC ENGINEERING CENTER     *
 *           VERSION 4.1               *        *         609 SECOND STREET           *
 *                                     *        *      DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   10DEC09  TIME  15:52:37 *        *         (916) 756-1104              *
 *                                     *        *                                     *
 ***************************************        ***************************************


            X     X  XXXXXXX   XXXXX          X
            X     X  X        X     X        XX
            X     X  X        X               X
            XXXXXXX  XXXX     X       XXXXX   X
            X     X  X        X               X
            X     X  X        X     X         X
            X     X  XXXXXXX   XXXXX         XXX


 THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

 THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
 THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
 NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
 DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
 KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM
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1                                     HEC-1 INPUT                                        PAGE  1

          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

          ID            WHITE TANKS AREA, WATERSHED CONTRIBUTING TO FRS#3
          ID            PREPARED BY HOSKIN RYAN CONSULTANTS EXCLUSIVELY FOR
          ID            FRS#3 OUTLET CHANNEL DESIGN, 12-05-2009
          ID            BASED ON HDR LOOP303/WHITE TANKS ADMPU AHA (09-04-09)
          ID            HEC-1 MODEL OF EXISTING CONDITION W/ CIP
          ID            MODIFICATIONS INCLUDE:
          ID            (1) UPDATE WITH AVERAGE RAINFALL DEPTH FOR FRS#3 WATERSHED ONLY
          ID            (2) UPDATE THE STAGE-STORAGE-DISCHARGE CURVE BASED ON URS DESIGN
          ID                OF FRS#3 PRINCIPAL AND EMERGENCY SPILLWAY (DISCHARGE
          ID                INCLUDING INFILTRATION)
          ID            (3) SEPARATE FRS#3 OUTFLOW AND INFILTRATION
          ID        ***********************************************************
          ID         Flood Control District of Maricopa County
          ID         L303_EX_CIP_MB02 - Loop 303/ White Tanks ADMPU AHA
          ID         100 YEAR
          ID         24 Hour Storm
          ID         Unit Hydrograph: S-Graph
          ID         08/18/2009
          ID            FCDMC CONTRACT 2007C031
          ID            BY HDR ENGINEERING (#79902)
          ID            EXISTING CONDITIONS WITH CIP-AUGUST 2009
          ID            MAJOR BASIN 02
          ID            FILE NAME: ECIP-MB2.DAT
          IT       5  1JAN99    1200     2000
          IN      15
          IO       5
          *DIAGRAM
          *
          JD   2.572  0.0001
          PC   0.000   0.002   0.005   0.008   0.011   0.014   0.017   0.020   0.023   0.026
          PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056   0.060
          PC   0.064   0.068   0.072   0.076   0.080   0.085   0.090   0.095   0.100   0.105
          PC   0.110   0.115   0.120   0.126   0.133   0.140   0.147   0.155   0.163   0.172
          PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
          PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
          PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
          PC   0.913   0.918   0.922   0.926   0.930   0.934   0.938   0.942   0.946   0.950
          PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977   0.980
          PC   0.983   0.986   0.989   0.992   0.995   0.998   1.000
          JD   2.443    10.0
          JD   2.315    30.0
          *

          KK     L21BASIN
          KM         BASIN BOUNDARY FROM MCMICKEN DAM ON THE WEST AND THE
          KM         BEARDSLEY CSR ON THE EAST
          BA   0.525
          LG    0.34    0.32    4.55    0.37       1
          UI       0      20      20      20      21      58      70      88     109     125
          UI     140     158     170     180     187     193     193     194     187     179
          UI     172     150     140     123     113     101      93      83      76      70
          UI      61      56      51      45      40      38      34      31      32      22
          UI      21      21      20      14      14      14      13      14      11       5
          *
```

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1                                     HEC-1 INPUT                                        PAGE  2

          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

          KK  DL21REDIVERT
          KM        Mass grading and Storage along canal
          DT    RL21    57.3     0.0
          DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
          DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
          *

          KK  L21L22ROUTE
          KM        Cross-section: Cross-section determined from A-team survey
          KM        Manning's N Value: earth w/sparse trees and brush, ponding against canal
          RS       1    FLOW
          RC   0.032   0.032   0.032    8793  0.0020    0.00
          RX  100.00  101.00  107.00  117.00  169.00  409.00  512.00  513.00
          RY  1328.1 1328.00 1326.00 1324.00 1324.10 1326.00 1328.00 1328.10
          *

          KK     L22BASIN
          KM         BASIN BOUNDARY FROM MCMICKEN DAM ON THE WEST AND THE
          KM         BEARDSLEY CSR ON THE EAST
          BA   0.362
          LG    0.34    0.34    4.35    0.39       0
          UI       0      19      19      21      56      79     101     124     144     162
          UI     170     183     184     177     172     154     133     117     103      89
          UI      78      68      59      52      43      38      36      29      28      20
          UI      20      18      13      13      13      12       5       5       4       5
          UI       5       4       5       4       5       5       4       0       0       0
          *

          KK  DL22REDIVERT
          KM        Storage along canal
          DT    RL22    15.6     0.0
          DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
          DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
          *

          KK   CPL22COMBINE
          HC       2   0.887
          *

          KK  L22W01ROUTE
          KM        Cross-section: Cross-section determined from 1991 topo
          KM        Manning's N Value: earth w/ sparse trees and brush
          RS       4    FLOW
          RC   0.032   0.032   0.032    3159  0.0063    0.00
          RX  100.00  101.00  102.00  115.00  128.00  140.00  141.00  142.00
          RY  1320.2 1320.10 1320.00 1314.00 1314.10 1320.00 1320.10 1320.20
          *

          KK     W01BASIN
          KM         BASIN BOUNDARY FROM FRS#3 ON THE WEST AND THE BEARDSLEY CSR ON THE EAST
          BA   0.191
          LG    0.34    0.34    3.95    0.40       0
          UI       0      38     144     258     304     262     170     110      71      44
          UI      29      21       8       7       8       0       0       0       0       0
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1                                     HEC-1 INPUT                                        PAGE  3

          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

          UI       0       0       0       0       0       0       0       0       0       0
          UI       0       0       0       0       0       0       0       0       0       0
          UI       0       0       0       0       0       0       0       0       0       0
          *

          KK   CPW01COMBINE
          HC       2   1.078
          *

          KK  W01W02ROUTE
          KM        Cross-section: Estimated 3' deep and 4:1 side slopes
          KM        width based on aerial
          KM        Manning's N Value: natural desert wash w/ vegetation
          RS       1    FLOW
          RC   0.035   0.035   0.035    2650  0.0053    0.00
          RX  100.00  111.00  122.00  139.00  162.00  182.00  191.00  200.00
          RY  1290.5 1290.25 1290.00 1286.00 1286.10 1290.00 1290.25 1290.50
          *

          KK     W02BASIN
          KM         BASIN BOUNDARY FROM 1990 TOPO, ALL FLOW TO SOUTH
          KM         MCMICKEN DAM ON THE WEST AND THE BEARDSLEY CSR ON THE EAST
          BA   0.394
          LG    0.35    0.35    4.65    0.32       0
          UI       0      56     195     370     497     530     435     300     209     145
          UI      99      70      46      38      14      13      14      13       0       0
          UI       0       0       0       0       0       0       0       0       0       0
          UI       0       0       0       0       0       0       0       0       0       0
          UI       0       0       0       0       0       0       0       0       0       0
          *

          KK   CPW02COMBINE
```

```
116          HC       2   1.472
             *

117          KK  W02W05ROUTE
118          KM        Cross-section: Natural Desert Wash w/ vegatation
119          RS       1    FLOW
120          RC   0.035   0.035   0.035    2214  0.0045    0.00
121          RX  100.00  106.00  112.00  119.00  135.00  137.00  138.00  141.00
122          RY  1280.0 1278.00 1277.00 1276.00 1275.90 1277.00 1278.00 1280.00
             *

123          KK     W03BASIN
124          KM        BASIN BOUNDARY FROM 1990 TOPO
125          BA   1.971
126          LG    0.35    0.35    4.00    0.47      20
127          UI       0     145     146     415     653     907    1064    1233    1685    1257
128          UI     947     849     756     672     606     522     442     374     341     315
129          UI     263     217     186     167     159     119     113     107      71      72
130          UI      70      71      37      27      28      28      28      28      28      28
131          UI      27      29      27       0       0       0       0       0       0       0
             *
1                                          HEC-1 INPUT                                          PAGE  4

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

132          KK  W03W04ROUTE
133          KM        Cross-section: Side slopes and width based on aerial and topo
134          KM        Manning's N Value: natural desert wash w/ vegetation
135          RS       3    FLOW
136          RC   0.035   0.035   0.035   18417  0.0490    0.00
137          RX  100.00  140.00  180.00  210.00  235.00  305.00  345.00  385.00
138          RY  1511.0 1510.50 1510.00 1502.00 1502.10 1510.00 1511.00 1512.00
             *

139          KK     W04BASIN
140          KM        BASIN BOUNDARY FROM 1990 TOPO
141          BA   2.034
142          LG    0.35    0.35    4.60    0.34      10
143          UI       0     144     147     379     620     881    1032    1176    1561    1470
144          UI     998     876     788     702     637     566     477     407     357     335
145          UI     304     239     203     188     158     157     113     111     105      72
146          UI      71      71      71      40      28      28      27      28       0       0
147          UI      28      28      27      28       0       0       0       0       0       0
             *

148          KK   CPW04COMBINE
149          HC       2   4.005
             *

150          KK  W04W05ROUTE
151          KM        Cross-section: Estimated 3' deep and 4:1 side slopes
152          KM        width based on aerial / Manning's N Value: clean straight earth
153          RS       2    FLOW
154          RC   0.035   0.035   0.035    5298  0.0098    0.00
155          RX  100.00  120.00  140.00  160.00  174.00  214.00  234.00  254.00
156          RY  1313.0 1312.50 1312.00 1308.00 1308.10 1312.00 1312.50 1313.00
             *

157          KK     W05BASIN
158          KM        BASIN BOUNDARY FROM 1990 TOPO AND BEARDSELY CSR
159          BA   0.316
160          LG    0.35    0.35    4.25    0.42       0
161          UI       0      32      62     147     214     282     302     300     260     199
162          UI     153     119      90      67      54      40      32      22      22       9
163          UI       7       8       8       8       8       0       0       0       0       0
164          UI       0       0       0       0       0       0       0       0       0       0
165          UI       0       0       0       0       0       0       0       0       0       0
             *

166          KK   CPW05COMBINE
167          HC       3   5.793
             *

168          KK  DW05SEDIVERT
169          KM        North Inlet Channel Divert from L303M3LA.OUT model given to HDR by
170          KM        FCDMC 05062009
171          DT   DW05S     0.0     0.0
172          DI   600.0   800.0  1000.0  1200.0  1400.0  1600.0  2000.0  2400.0  2715.0  2800.0
173          DQ   105.0   163.0   361.0   498.0   640.0   792.0  1100.0  1437.0  1605.0  1630.0
             *
1                                          HEC-1 INPUT                                          PAGE  5

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

174          KK  W0512AROUTE
175          KM        White Tanks FRS#3 North Inlet Channel South
176          KM        Channel plans FCD Contract No 2007C021
177          KM        Cholla Wash
178          RS       3    FLOW
179          RC   0.050   0.030   0.050    5306  0.0083    0.00
180          RX  1010.0 1015.00 1020.00 1050.00 1100.00 1275.00 1580.00 1750.00
181          RY  1251.0 1249.00 1249.00 1245.00 1244.90 1250.00 1250.00 1254.00
             *

182          KK     W06BASIN
183          KM        BASIN BOUNDARY FROM 1990 TOPO
184          BA   0.707
185          LG    0.35    0.35    4.30    0.41      18
186          UI       0     103     362     675     987     837     576     461     363     257
187          UI     217     150     119      90      72      49      48      20      20      19
188          UI      20      20       0       0       0       0       0       0       0       0
189          UI       0       0       0       0       0       0       0       0       0       0
190          UI       0       0       0       0       0       0       0       0       0       0
             *

191          KK     W07BASIN
192          KM        BASIN BOUNDARY FROM 1990 TOPO
193          BA   0.312
194          LG    0.35    0.35    4.25    0.42      19
195          UI       0      65     253     428     510     316     236     171     126      89
196          UI      63      46      33      26      14      11      10      10       0       0
197          UI       0       0       0       0       0       0       0       0       0       0
198          UI       0       0       0       0       0       0       0       0       0       0
199          UI       0       0       0       0       0       0       0       0       0       0
             *

200          KK   CPW07COMBINE
201          HC       2   1.019
             *

202          KK  W07W08ROUTE
203          KM        Cross-section: Based on aerial and topo
204          KM        Manning's N Value: Natural Desert wash w/ vegetation
205          KM        N value modified to slow velocity
206          RS       1    FLOW
207          RC   0.045   0.040   0.045    5589  0.0796    0.00
208          RX  100.00  136.00  173.00  197.00  234.00  254.00  298.00  342.00
209          RY  2880.0 2865.00 2850.00 2840.00 2840.00 2850.00 2865.00 2880.00
             *

210          KK     W08BASIN
211          KM        BASIN BOUNDARY FROM 1990 TOPO
212          BA   0.446
213          LG    0.35    0.35    3.95    0.40      20
214          UI       0     156     587     941     577     413     262     183     117      78
215          UI      49      32      19      19      19       0       0       0       0       0
216          UI       0       0       0       0       0       0       0       0       0       0
217          UI       0       0       0       0       0       0       0       0       0       0
1                                          HEC-1 INPUT                                          PAGE  6

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

218          UI       0       0       0       0       0       0       0       0       0       0
             *

219          KK   CPW08COMBINE
220          HC       2   1.465
             *

221          KK     W09BASIN
222          KM        BASIN BOUNDARY FROM 1990 TOPO
223          BA   0.335
224          LG    0.35    0.35    3.95    0.40      20
225          UI       0     125     468     716     427     304     193     127      85      53
226          UI      37      19      14      15       0       0       0       0       0       0
227          UI       0       0       0       0       0       0       0       0       0       0
228          UI       0       0       0       0       0       0       0       0       0       0
229          UI       0       0       0       0       0       0       0       0       0       0
             *

230          KK   CPW09COMBINE
231          HC       2     1.8
             *

232          KK  W09W10ROUTE
233          KM        Cross-section: Based on aerial and topo
234          KM        Manning's N Value: Natural Desert wash w/ vegetation
235          KM        N value modified to slow velocity
236          RS       1    FLOW
237          RC   0.045   0.040   0.045   11134  0.0683    0.00
238          RX  100.00  137.00  172.00  192.00  220.00  230.00  284.00  338.00
239          RY  1990.0 1975.00 1960.00 1950.00 1950.00 1960.00 1975.00 1990.00
             *

240          KK     W10BASIN
241          KM        BASIN BOUNDARY FROM 1990 TOPO
242          BA   1.338
243          LG    0.35    0.35    3.95    0.40      20
244          UI       0     153     376     806    1108    1572    1334     920     794     647
245          UI     533     402     350     278     212     175     141     119      85      75
246          UI      75      29      30      30      29      30      29       0       0       0
247          UI       0       0       0       0       0       0       0       0       0       0
248          UI       0       0       0       0       0       0       0       0       0       0
             *

249          KK   CPW10COMBINE
250          HC       2   3.138
             *
```

```
251          KK     W11BASIN
252          KM        BASIN BOUNDARY FROM 1990 TOPO
253          BA   0.812
254          LG    0.35    0.35    3.95    0.40      20
255          UI       0     100     272     567     759    1098     696     556     469     375
256          UI     285     236     190     141     116      92      77      52      48      39
257          UI      20      19      19      19      19      20       0       0       0       0
258          UI       0       0       0       0       0       0       0       0       0       0
1                                          HEC-1 INPUT                                          PAGE  7

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

259          UI       0       0       0       0       0       0       0       0       0       0
             *

260          KK   CPW11COMBINE
261          HC       2    3.95
             *

262          KK  W11W12ROUTE
263          KM        Cross-section: Based on aerial and topo
264          KM        Manning's N Value: Natural Desert wash w/ vegetation
265          RS       8    FLOW
266          RC   0.045   0.035   0.045   21182  0.0205    0.00
267          RX  100.00  110.30  290.50  304.40  319.20  330.60  344.60  569.70
268          RY  1312.0 1310.00 1308.00 1306.00 1305.90 1308.00 1310.00 1312.00
             *

269          KK     W12BASIN
270          KM        BASIN BOUNDARY FROM 1990 TOPO AND BEARDSELY CSR
271          BA   1.868
272          LG    0.34    0.34    4.60    0.34       3
273          UI       0     125     126     289     490     706     847     961    1170    1474
274          UI    1002     820     727     654     604     537     483     418     353     310
275          UI     293     266     221     193     160     148     139     120      96      96
276          UI      83      61      61      61      61      37      24      24      24      24
277          UI      24      25      24      24      24      24      24       0       0       0
             *

278          KK  DW05SERETRIEVE
279          KM        Flow traveling down North Inlet Channel
280          DR   DW05S
             *

281          KK  W0512BROUTE
282          KM        White Tanks FRS#3 North Inlet Channel South
283          KM        Channel plans FCD Contract No 2007C021
284          KM        N value modifeid to mimic slowing of velocity by drop structures
285          RS       2    FLOW
286          RC   0.035   0.035   0.035    5494  0.0170    0.00
287          RX  100.00  120.00  135.00  165.00  220.00  300.00  315.00  379.00
288          RY  1244.7 1239.65 1239.50 1232.00 1231.90 1239.50 1239.65 1255.65
             *

289          KK   CPW12COMBINE
290          HC       4   11.61
             *

291          KK  W12W13ROUTE
292          KM        From NIC South Channel Plans at Sta. 535+00
293          RS       1    FLOW
294          RC   0.032   0.032   0.032    2062  0.0051    0.00
295          RX  100.00  120.00  162.50  205.00  355.00  397.50  440.00  460.00
296          RY  1218.4 1218.18 1211.10 1203.98 1204.45 1211.53 1218.65 1218.85
             *
1                                          HEC-1 INPUT                                          PAGE  8

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

297          KK     W13BASIN
298          KM        BASIN BOUNDARY FROM 1990 TOPO AND BEARDSELY CSR
299          BA   1.584
300          LG    0.35    0.35    4.90    0.29       3
301          UI       0     107     108     254     430     622     734     838    1035    1255
302          UI     820     689     615     557     511     445     405     352     287     261
303          UI     248     223     176     154     137     121     119      90      83      83
304          UI      59      52      53      53      48      21      20      21      20      21
305          UI      20      21      21      20      21      21       0       0       0       0
             *

306          KK   CPW13COMBINE
307          HC       2   13.194
             *

308          KK  W13W16ROUTE
309          KM        From NIC South Channel Plans
310          KM        at Sta. 523+00
311          RS       2    FLOW
312          RC   0.032   0.032   0.032    6257  0.0051    0.00
313          RX  100.00  115.00  162.00  209.10  359.10  435.90  465.00  480.00
314          RY  1216.9 1216.77 1208.93 1201.09 1203.09 1215.09 1223.54 1223.69
             *

315          KK     W15BASIN
316          KM        BASIN BOUNDARY FROM 1990 TOPO
317          BA   1.227
318          LG    0.35    0.35    4.55    0.35       0
319          UI       0      98     112     315     498     652     757     975    1045     671
320          UI     578     523     457     400     352     284     245     227     196     161
321          UI     128     117     107      86      75      70      49      48      47      43
322          UI      19      18      19      19      19      19      18      19      19       0
323          UI       0       0       0       0       0       0       0       0       0       0
             *

324          KK     W14BASIN
325          KM        BASIN BOUNDARY FROM 1990 TOPO
326          BA   1.582
327          LG    0.35    0.37    5.20    0.25       3
328          UI       0     165     333     776    1104    1420    1804    1142     948     811
329          UI     682     567     431     386     320     242     201     182     128     124
330          UI      82      80      79      32      32      32      32      31      32      32
331          UI       0       0       0       0       0       0       0       0       0       0
332          UI       0       0       0       0       0       0       0       0       0       0
             *

333          KK  W14W15ROUTE
334          KM        Cross-section: Based on aerial and topo
335          KM        Manning's N Value: Natural Desert wash w/ vegetation
336          RS       3    FLOW
337          RC   0.035   0.035   0.035    7308  0.0104    0.00
338          RX  100.00  130.00  150.00  184.00  210.00  226.00  246.00  276.00
339          RY  1280.0 1276.00 1274.00 1270.00 1269.90 1274.00 1276.00 1280.00
             *
1                                          HEC-1 INPUT                                          PAGE  9

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

340          KK   CPW15COMBINE
341          HC       2    2.809
             *

342          KK  W15W16ROUTE
343          KM        Cross-section: Based on aerial and topo
344          KM        Manning's N Value: Natural Desert wash w/ vegetation
345          RS       1    FLOW
346          RC   0.035   0.035   0.035    2750  0.0087    0.00
347          RX  100.00  135.00  232.00  328.00  360.00  498.00  635.00  735.00
348          RY  1202.0 1200.00 1199.00 1198.00 1197.90 1199.00 1200.00 1202.00
             *

349          KK     W16BASIN
350          KM        BASIN BOUNDARY FROM BEARDSLEY CSR, THE FRS#4 AND 1990 TOPO
351          BA   0.530
352          LG    0.22    0.22    4.55    0.33       0
353          UI       0      61     148     318     464     562     575     509     384     282
354          UI     211     157     115      87      65      42      42      15      14      15
355          UI      15      15       0       0       0       0       0       0       0       0
356          UI       0       0       0       0       0       0       0       0       0       0
357          UI       0       0       0       0       0       0       0       0       0       0
             *

358          KK   CPW16COMBINE
359          HC       3   16.534
             *

360          KK  W16W20ROUTE
361          KM        Cross-section: Based on aerial and topo
362          KM        Manning's N Value: clean earth; straight
363          RS       1    FLOW
364          RC   0.022   0.022   0.022    3633  0.0130    0.00
365          RX  100.00  113.00  127.00  136.00  245.00  272.00  318.00  384.00
366          RY  1186.0 1184.00 1182.00 1180.00 1179.90 1182.00 1184.00 1186.00
             *

367          KK     W18BASIN
368          KM        BASIN BOUNDARY FROM 1990 TOPO
369          BA   1.260
370          LG    0.35    0.35    4.40    0.38       8
371          UI       0      38      38      38      38      38      99     112     147     168
372          UI     200     230     242     261     278     296     307     348     390     440
373          UI     461     337     285     264     241     228     223     213     202     195
374          UI     185     177     171     161     152     148     137     130     119     110
375          UI     100      97      93      90      89      86      79      81      68      62
             *

376          KK     W17BASIN
377          KM        BASIN BOUNDARY FROM 1990 TOPO
378          BA   1.497
379          LG    0.35    0.35    4.30    0.41      18
380          UI       0     169     396     865    1197    1639    1571    1038     892     737
381          UI     607     469     398     324     247     201     173     131     110      82
1                                          HEC-1 INPUT                                          PAGE 10

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

382          UI      83      52      32      33      32      32      33      32       0       0
383          UI       0       0       0       0       0       0       0       0       0       0
```

```
384        UI       0       0       0       0       0       0       0       0       0       0
           *

385        KK  W17W18ROUTE
386        KM        Cross-section: Based on aerial and topo
387        KM        Manning's N Value: natural desert wash w/ vegetation
388        KM        and heavy vegetation
389        RS       2    FLOW
390        RC   0.045   0.035   0.045    8559  0.0257    0.00
391        RX  100.00  140.00  150.00  156.00  194.00  216.00  255.00  342.00
392        RY  1302.0 1300.00 1298.00 1296.00 1295.90 1298.00 1300.00 1302.00
           *

393        KK   CPW18COMBINE
394        HC       2   2.757
           *

395        KK  W18W20ROUTE
396        KM        Cross-section: Estimated 3' deep, side slopes and width based
397        KM        on aerial / Manning's N Value: natural desert wash w/ vegetation
398        RS       5    FLOW
399        RC   0.035   0.035   0.035    6914  0.0058    0.00
400        RX  100.00  155.00  170.00  210.00  216.00  256.00  276.00  336.00
401        RY  1249.0 1248.25 1248.00 1245.00 1245.10 1248.00 1248.25 1249.00
           *

402        KK     W19BASIN
403        KM        BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
404        KM        WOOD/PATEL (2006) MODIFIED SLIGHTLY TO MATCH 1990 2' CI TOPO
405        BA   1.158
406        LG    0.35    0.35    3.88    0.42      20
407        UI       0     241     939    1587    1896    1172     876     636     467     328
408        UI     236     172     119      99      51      39      39      39       0       0
409        UI       0       0       0       0       0       0       0       0       0       0
410        UI       0       0       0       0       0       0       0       0       0       0
411        UI       0       0       0       0       0       0       0       0       0       0
           *

412        KK   SRW19STORAGE
413        KM        Master Drainage Plan for the Caterpillar Property (Basin #16)
414        KO
415        RS       1    STOR
416        SV            1.00   31.00  114.00  270.00  502.00  807.00 1319.00 1388.00 1460.00
417        SQ                                                                          135.00
418        SE  1198.0 1200.00 1210.00 1220.00 1230.00 1240.00 1250.00 1260.00 1261.00 1262.00
419        ST
           *
```



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LINE       ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

420        KK  W19W20ROUTE
421        KM        Cross-section: Estimated 4' deep and 3:1 side slopes, width based
422        KM        on aerial / Manning's N Value: earth with sparse treese and shrubs
423        RS       1    FLOW
424        RC   0.032   0.032   0.032    3790  0.0158    0.00
425        RX  100.00  120.00  140.00  152.00  158.00  170.00  190.00  210.00
426        RY  1240.5 1240.25 1240.00 1236.00 1236.00 1240.00 1240.25 1240.50
           *

427        KK     W20BASIN
428        KM        BASIN BOUNDARY FROM WHITE TANKS #4 FRS, S-S-D CURVES
429        KM        FROM JAN 2009 FCDMC, AND FROM 1990 TOPO
430        BA   1.137
431        LG    0.29    0.29    4.10    0.44       0
432        UI       0     104     165     390     618     777     969    1101     712     596
433        UI     525     458     389     315     265     233     199     157     131     115
434        UI      98      80      71      51      50      51      26      19      20      20
435        UI      20      20      20      20      20       0       0       0       0       0
436        UI       0       0       0       0       0       0       0       0       0       0
           *

437        KK   CPW20COMBINE
438        HC       4  21.586
           *

439        KK   SRW20 STORAGE
440        KM   STAGE-STORAGE-DISCHARGE CURVE FROM URS DESIGN OF FRS#3 OUTLET STRUCTURE
441        KM   THE DISCHARGE INCLUDING OUTFLOW FROM PRINCIPAL AND EMERGENCY SPILLWAY,
442        KM   AS WELL AS INFILTRATION
443        RS       1    STOR      -1
444        SV    44.8     388     585     846    1002    2045    3218    3557    4693    6510
445        SQ    0.02    0.17     4.5     187     203     276     330    2936   24545   70439
446        SE    1188    1198    1200    1202    1203    1208    1212    1213    1216    1220
           *

447        KK   OUTFL
448        KM   SEPRATE OUTFLOW FROM INFILTRATION
           * KO      1
449        ZW   A=WT B=FRS3 C=FLOW
450        DT    INFL
451        DI       0     4.5      86     203     330    2936   24545   70439
452        DQ       0     4.5      10      22      73      79      96     121
453        ZZ
```

```
1
                    SCHEMATIC DIAGRAM OF STREAM NETWORK
INPUT
 LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

  40         L21
                .
                .
  52            .------->    RL21
  50       DL21RE
                V
                V
  55       L21L22
                .
                .
  62            .         L22
                .           .
                .           .
  74            .           .------->    RL22
  72            .      DL22RE
                .           .
                .           .
  77        CPL22............
                V
                V
  79       L22W01
                .
                .
  86            .         W01
                .           .
                .           .
  95        CPW01............
                V
                V
  97       W01W02
                .
                .
 105            .         W02
                .           .
                .           .
 115        CPW02............
                V
                V
 117       W02W05
                .
                .
 123            .         W03
                .           V
                .           V
 132            .      W03W04
                .           .
                .           .
 139            .           .         W04
                .           .           .
                .           .           .
 148            .      CPW04............
                .           V
                .           V
 150            .      W04W05
                .           .
                .           .
 157            .           .         W05
                .           .           .
                .           .           .
 166        CPW05........................
                .
                .
 171            .------->   DW05S
 168       DW05SE
                V
                V
 174       W0512A
                .
                .
 182            .         W06
                .           .
                .           .
 191            .           .         W07
                .           .           .
                .           .           .
 200            .      CPW07............
                .           V
                .           V
 202            .      W07W08
                .           .
                .           .
 210            .           .         W08
                .           .           .
                .           .           .
 219            .      CPW08............
                .           .
                .           .
 221            .           .         W09
```

```
                .         .         .
                .         .         .
230             .      CPW09.........
                .         V
                .         V
232             .      W09W10
                .         .
                .         .
240             .         .      W10
                .         .         .
                .         .         .
249             .      CPW10.........
                .         .
                .         .
251             .         .      W11
                .         .         .
                .         .         .
260             .      CPW11.........
                .         V
                .         V
262             .      W11W12
                .         .
                .         .
269             .         .      W12
                .         .         .
                .         .         .
280             .         .         .<-------   DW05S
278             .         .      DW05SE
                .         .         V
                .         .         V
281             .         .      W0512B
                .         .         .
                .         .         .
289          CPW12.................................
                V
                V
291          W12W13
                .
                .
297             .      W13
                .         .
                .         .
306          CPW13.........
                V
                V
308          W13W16
                .
                .
315             .      W15
                .         .
                .         .
324             .         .      W14
                .         .         V
                .         .         V
333             .         .    W14W15
                .         .         .
                .         .         .
340             .      CPW15.........
                .         V
                .         V
342             .      W15W16
                .         .
                .         .
349             .         .      W16
                .         .         .
                .         .         .
358          CPW16........................
                V
                V
360          W16W20
                .
                .
367             .      W18
                .         .
                .         .
376             .         .      W17
                .         .         V
                .         .         V
385             .         .    W17W18
                .         .         .
                .         .         .
393             .      CPW18.........
                .         V
                .         V
395             .      W18W20
                .         .
                .         .
402             .         .      W19
                .         .         V
                .         .         V
412             .         .     SRW19
                .         .         V
                .         .         V
420             .         .    W19W20
                .         .         .
```

```
                .         .         .
427             .         .         .      W20
                .         .         .         .
                .         .         .         .
437          CPW20.................................
                V
                V
439          SRW20
                .
                .
450             .------->   INFL
447          OUTFL
```

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	L21	81.	13.25	24.	6.	2.	.52		
+	DIVERSION TO	RL21	81.	13.25	24.	6.	2.	.52		
+	HYDROGRAPH AT	DL21RE	0.	.00	0.	0.	0.	.52		
+	ROUTED TO	L21L22	0.	.00	0.	0.	0.	.52		
+	HYDROGRAPH AT	L22	72.	12.92	15.	4.	1.	.36		
+	DIVERSION TO	RL22	72.	12.92	15.	4.	1.	.36		
+	HYDROGRAPH AT	DL22RE	0.	.00	0.	0.	0.	.36		
+	2 COMBINED AT	CPL22	0.	.00	0.	0.	0.	.89		
+	ROUTED TO	L22W01	0.	.00	0.	0.	0.	.89		
+	HYDROGRAPH AT	W01	112.	12.25	8.	2.	1.	.19		
+	2 COMBINED AT	CPW01	111.	12.25	8.	2.	1.	1.08		
+	ROUTED TO	W01W02	75.	12.42	8.	2.	1.	1.08		
+	HYDROGRAPH AT	W02	209.	12.33	18.	5.	2.	.39		
+	2 COMBINED AT	CPW02	274.	12.33	26.	7.	2.	1.47		
+	ROUTED TO	W02W05	240.	12.42	26.	7.	2.	1.47		
+	HYDROGRAPH AT	W03	658.	12.58	132.	41.	14.	1.97		
+	ROUTED TO	W03W04	525.	12.92	132.	41.	14.	1.97		
+	HYDROGRAPH AT	W04	651.	12.58	118.	33.	11.	2.03		
+	2 COMBINED AT	CPW04	999.	12.67	248.	74.	25.	4.01		
+	ROUTED TO	W04W05	940.	12.92	248.	74.	25.	4.01		
+	HYDROGRAPH AT	W05	110.	12.42	13.	3.	1.	.32		
+	3 COMBINED AT	CPW05	1066.	12.83	286.	83.	28.	5.79		
+	DIVERSION TO	DW05S	406.	12.83	110.	39.	13.	5.79		
+	HYDROGRAPH AT	DW05SE	660.	12.83	176.	44.	15.	5.79		
	ROUTED TO									

```
+                    W0512A     649.  13.08      176.      44.      15.      5.79
      HYDROGRAPH AT
+                       W06     387.  12.25       47.      14.       5.       .71
      HYDROGRAPH AT
+                       W07     194.  12.25       21.       6.       2.       .31
      2 COMBINED AT
+                     CPW07     578.  12.25       68.      21.       7.      1.02
      ROUTED TO
+                    W07W08     516.  12.33       68.      21.       7.      1.02
      HYDROGRAPH AT
+                       W08     337.  12.17       32.      10.       3.       .45
      2 COMBINED AT
+                     CPW08     761.  12.25      100.      30.      10.      1.47
      HYDROGRAPH AT
+                       W09     258.  12.17       24.       7.       2.       .34
      2 COMBINED AT
+                     CPW09     992.  12.25      124.      37.      13.      1.80
      ROUTED TO
+                    W09W10     748.  12.42      124.      37.      13.      1.80
      HYDROGRAPH AT
+                       W10     663.  12.33       95.      29.      10.      1.34
      2 COMBINED AT
+                     CPW10    1379.  12.42      218.      66.      22.      3.14
      HYDROGRAPH AT
+                       W11     423.  12.33       58.      18.       6.       .81
      2 COMBINED AT
+                     CPW11    1785.  12.33      275.      83.      28.      3.95
      ROUTED TO
+                    W11W12    1304.  13.08      275.      83.      28.      3.95
      HYDROGRAPH AT
+                       W12     527.  12.67       91.      24.       8.      1.87
      HYDROGRAPH AT
+                    DW05SE     406.  12.83      110.      39.      13.      5.79
      ROUTED TO
+                    W0512B     350.  13.08      110.      39.      13.      5.79
      4 COMBINED AT
+                     CPW12    2513.  13.08      638.     186.      62.     11.61
      ROUTED TO
+                    W12W13    2489.  13.17      638.     186.      62.     11.61
      HYDROGRAPH AT
+                       W13     470.  12.67       81.      21.       7.      1.58
      2 COMBINED AT
+                     CPW13    2669.  13.08      708.     205.      69.     13.19
      ROUTED TO
+                    W13W16    2577.  13.33      707.     205.      69.     13.19
      HYDROGRAPH AT
+                       W15     373.  12.50       53.      13.       4.      1.23
      HYDROGRAPH AT
+                       W14     677.  12.42       83.      22.       7.      1.58
      ROUTED TO
+                    W14W15     557.  12.67       83.      22.       7.      1.58
      2 COMBINED AT
+                     CPW15     897.  12.58      135.      35.      12.      2.81
      ROUTED TO
+                    W15W16     738.  12.75      135.      35.      12.      2.81
      HYDROGRAPH AT
+                       W16     284.  12.42       30.       8.       3.       .53
      3 COMBINED AT
+                     CPW16    2925.  13.25      847.     240.      80.     16.53
      ROUTED TO
+                    W16W20    2910.  13.33      846.     240.      80.     16.53
      HYDROGRAPH AT
+                       W18     193.  13.50       60.      17.       6.      1.26
      HYDROGRAPH AT
+                       W17     687.  12.33      100.      30.      10.      1.50
      ROUTED TO
+                    W17W18     563.  12.58       99.      30.      10.      1.50
      2 COMBINED AT
+                     CPW18     630.  12.58      159.      46.      16.      2.76
      ROUTED TO
+                    W18W20     560.  13.00      158.      46.      16.      2.76
      HYDROGRAPH AT
+                       W19     740.  12.25       82.      25.       8.      1.16
      ROUTED TO
+                     SRW19       0.    .00        0.       0.       0.      1.16
      ROUTED TO
+                    W19W20       0.    .00        0.       0.       0.      1.16
      HYDROGRAPH AT
+                       W20     384.  12.42       50.      12.       4.      1.14
      4 COMBINED AT
+                     CPW20    3339.  13.25     1016.     289.      97.     21.59
      ROUTED TO
+                     SRW20      18.  27.33       18.      14.       8.     21.59
      DIVERSION TO
+                      INFL       5.  27.17        5.       5.       5.     21.59
      HYDROGRAPH AT
+                     OUTFL      13.  27.33       12.       9.       3.     21.59
1                   SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION    SRW19
                 (PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED  DURING BREACH FORMATION)


PLAN  1 ..............                 INITIAL VALUE     SPILLWAY CREST     TOP OF DAM
                              ELEVATION       1198.00             .00             .00
                              STORAGE              0.              0.              0.
                              OUTFLOW              0.              0.              0.

                      RATIO    MAXIMUM     MAXIMUM    MAXIMUM    MAXIMUM    DURATION    TIME OF    TIME OF
                         OF  RESERVOIR      DEPTH    STORAGE    OUTFLOW    OVER TOP  MAX OUTFLOW   FAILURE
                        PMF    W.S.ELEV   OVER DAM     AC-FT        CFS       HOURS       HOURS     HOURS

                       1.00    1212.59    1212.59        52.         0.    166.58         .00       .00

PLAN  2 ..............                 INITIAL VALUE     SPILLWAY CREST     TOP OF DAM
                              ELEVATION       1198.00             .00             .00
                              STORAGE              0.              0.              0.
                              OUTFLOW              0.              0.              0.

                      RATIO    MAXIMUM     MAXIMUM    MAXIMUM    MAXIMUM    DURATION    TIME OF    TIME OF
                         OF  RESERVOIR      DEPTH    STORAGE    OUTFLOW    OVER TOP  MAX OUTFLOW   FAILURE
                        PMF    W.S.ELEV   OVER DAM     AC-FT        CFS       HOURS       HOURS     HOURS

                       1.00    1212.12    1212.12        49.         0.    166.58         .00       .00

PLAN  3 ..............                 INITIAL VALUE     SPILLWAY CREST     TOP OF DAM
                              ELEVATION       1198.00             .00             .00
                              STORAGE              0.              0.              0.
                              OUTFLOW              0.              0.              0.

                      RATIO    MAXIMUM     MAXIMUM    MAXIMUM    MAXIMUM    DURATION    TIME OF    TIME OF
                         OF  RESERVOIR      DEPTH    STORAGE    OUTFLOW    OVER TOP  MAX OUTFLOW   FAILURE
                        PMF    W.S.ELEV   OVER DAM     AC-FT        CFS       HOURS       HOURS     HOURS

                       1.00    1211.65    1211.65        45.         0.    166.58         .00       .00


*** NORMAL END OF HEC-1 ***
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A.9 EXISTING CONDITIONS 100-YEAR FOR FRS#3 MAJOR BASIN

```
1***************************************                    ***************************************
 *                                     *                    *                                     *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1) *                    *   U.S. ARMY CORPS OF ENGINEERS      *
 *              JUN   1998             *                    *   HYDROLOGIC ENGINEERING CENTER     *
 *            VERSION 4.1              *                    *         609 SECOND STREET           *
 *                                     *                    *      DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   05DEC09  TIME  14:12:37 *                    *         (916) 756-1104              *
 *                                     *                    *                                     *
 ***************************************                    ***************************************


                         X     X  XXXXXXX   XXXXX          X
                         X     X  X        X     X        XX
                         X     X  X        X               X
                         XXXXXXX  XXXX     X       XXXXX   X
                         X     X  X        X               X
                         X     X  X        X     X         X
                         X     X  XXXXXXX   XXXXX         XXX


  THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

  THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
  THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
  NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
  DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
  KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                    HEC-1 INPUT                                          PAGE  1

 LINE       ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

    1       ID         WHITE TANKS AREA, WATERSHED CONTRIBUTING TO FRS#3
    2       ID         PREPARED BY HOSKIN RYAN CONSULTANTS EXCLUSIVELY FOR
    3       ID         FRS#3 OUTLET CHANNEL DESIGN, 12-05-2009
    4       ID         BASED ON HDR LOOP303/WHITE TANKS ADMPU AHA (09-04-09)
    5       ID         HEC-1 MODEL OF EXISTING CONDITION W/ CIP
    6       ID         MODIFICATIONS INCLUDE:
    7       ID         (1) UPDATE WITH AVERAGE RAINFALL DEPTH FOR FRS#3 WATERSHED ONLY
    8       ID         (2) UPDATE THE STAGE-STORAGE-DISCHARGE CURVE BASED ON URS DESIGN
    9       ID             OF FRS#3 PRINCIPAL AND EMERGENCY SPILLWAY (DISCHARGE
   10       ID             INCLUDING INFILTRATION)
   11       ID         (3) SEPARATE FRS#3 OUTFLOW AND INFILTRATION
   12       ID     *************************************************************
   13       ID          Flood Control District of Maricopa County
   14       ID          L303_EX_CIP_MB02 - Loop 303/ White Tanks ADMPU AHA
   15       ID          100 YEAR
   16       ID          24 Hour Storm
   17       ID          Unit Hydrograph: S-Graph
   18       ID          08/18/2009
   19       ID             FCDMC CONTRACT 2007C031
   20       ID             BY HDR ENGINEERING (#79902)
   21       ID             EXISTING CONDITIONS WITH CIP-AUGUST 2009
   22       ID             MAJOR BASIN 02
   23       ID             FILE NAME: ECIP-MB2.DAT
   24       IT       5  1JAN99    1200    2000
   25       IN      15
   26       IO       5
            *DIAGRAM
            *
   27       JD   4.016  0.0001
   28       PC   0.000   0.002   0.005   0.008   0.011   0.014   0.017   0.020   0.023   0.026
   29       PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056   0.060
   30       PC   0.064   0.068   0.072   0.076   0.080   0.085   0.090   0.095   0.100   0.105
   31       PC   0.110   0.115   0.120   0.126   0.133   0.140   0.147   0.155   0.163   0.172
   32       PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
   33       PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
   34       PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
   35       PC   0.913   0.918   0.922   0.926   0.930   0.934   0.938   0.942   0.946   0.950
   36       PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977   0.980
   37       PC   0.983   0.986   0.989   0.992   0.995   0.998   1.000
   38       JD   3.815    10.0
   39       JD   3.614    30.0
            *

   40       KK     L21BASIN
   41       KM          BASIN BOUNDARY FROM MCMICKEN DAM ON THE WEST AND THE
   42       KM          BEARDSLEY CSR ON THE EAST
   43       BA   0.525
   44       LG    0.34    0.32    4.55    0.37       1
   45       UI       0      20      20      20      21      58      70      88     109     125
   46       UI     140     158     170     180     187     193     193     194     187     179
   47       UI     172     150     140     123     113     101      93      83      76      70
   48       UI      61      56      51      45      40      38      34      31      32      22
   49       UI      21      21      20      14      14      14      13      14      11       5
            *
1                                    HEC-1 INPUT                                          PAGE  2

 LINE       ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

   50       KK  DL21REDIVERT
   51       KM        Mass grading and Storage along canal
   52       DT    RL21    57.3     0.0
   53       DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
   54       DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
            *

   55       KK  L21L22ROUTE
   56       KM        Cross-section: Cross-section determined from A-team survey
   57       KM        Manning's N Value: earth w/sparse trees and brush, ponding against canal
   58       RS       1    FLOW
   59       RC   0.032   0.032   0.032    8793  0.0020    0.00
   60       RX  100.00  101.00  107.00  117.00  169.00  409.00  512.00  513.00
   61       RY  1328.1 1328.00 1326.00 1324.00 1324.10 1326.00 1328.00 1328.10
            *

   62       KK     L22BASIN
   63       KM        BASIN BOUNDARY FROM MCMICKEN DAM ON THE WEST AND THE
   64       KM        BEARDSLEY CSR ON THE EAST
   65       BA   0.362
   66       LG    0.34    0.34    4.35    0.39       0
   67       UI       0      19      19      21      56      79     101     124     144     162
   68       UI     170     183     184     177     172     154     133     117     103      89
   69       UI      78      68      59      52      43      38      36      29      28      20
   70       UI      20      18      13      13      13      12       5       5       4       5
   71       UI       5       4       5       4       5       5       4       0       0       0
            *

   72       KK  DL22REDIVERT
   73       KM        Storage along canal
   74       DT    RL22    15.6     0.0
   75       DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
   76       DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
            *

   77       KK   CPL22COMBINE
   78       HC       2   0.887
            *

   79       KK  L22W01ROUTE
   80       KM        Cross-section: Cross-section determined from 1991 topo
   81       KM        Manning's N Value: earth w/ sparse trees and brush
   82       RS       4    FLOW
   83       RC   0.032   0.032   0.032    3159  0.0063    0.00
   84       RX  100.00  101.00  102.00  115.00  128.00  140.00  141.00  142.00
   85       RY  1320.2 1320.10 1320.00 1314.00 1314.10 1320.00 1320.10 1320.20
            *

   86       KK     W01BASIN
   87       KM        BASIN BOUNDARY FROM FRS#3 ON THE WEST AND THE BEARDSLEY CSR ON THE EAST
   88       BA   0.191
   89       LG    0.34    0.34    3.95    0.40       0
   90       UI       0      38     144     258     304     262     170     110      71      44
   91       UI      29      21       8       7       8       0       0       0       0       0
1                                    HEC-1 INPUT                                          PAGE  3

 LINE       ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

   92       UI       0       0       0       0       0       0       0       0       0       0
   93       UI       0       0       0       0       0       0       0       0       0       0
   94       UI       0       0       0       0       0       0       0       0       0       0
            *

   95       KK   CPW01COMBINE
   96       HC       2   1.078
            *

   97       KK  W01W02ROUTE
   98       KM        Cross-section: Estimated 3' deep and 4:1 side slopes
   99       KM        width based on aerial
  100       KM        Manning's N Value: natural desert wash w/ vegetation
  101       RS       1    FLOW
  102       RC   0.035   0.035   0.035    2650  0.0053    0.00
  103       RX  100.00  111.00  122.00  139.00  162.00  182.00  191.00  200.00
  104       RY  1290.5 1290.25 1290.00 1286.00 1286.10 1290.00 1290.25 1290.50
            *

  105       KK     W02BASIN
  106       KM        BASIN BOUNDARY FROM 1990 TOPO, ALL FLOW TO SOUTH
  107       KM        MCMICKEN DAM ON THE WEST AND THE BEARDSLEY CSR ON THE EAST
  108       BA   0.394
  109       LG    0.35    0.35    4.65    0.32       0
  110       UI       0      56     195     370     497     530     435     300     209     145
  111       UI      99      70      46      38      14      13      14      13       0       0
  112       UI       0       0       0       0       0       0       0       0       0       0
  113       UI       0       0       0       0       0       0       0       0       0       0
  114       UI       0       0       0       0       0       0       0       0       0       0
            *
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```
115          KK   CPW02COMBINE
116          HC       2   1.472
             *

117          KK  W02W05ROUTE
118          KM        Cross-section: Natural Desert Wash w/ vegatation
119          RS       1    FLOW
120          RC   0.035   0.035   0.035    2214  0.0045    0.00
121          RX  100.00  106.00  112.00  119.00  135.00  137.00  138.00  141.00
122          RY  1280.0 1278.00 1277.00 1276.00 1275.90 1277.00 1278.00 1280.00
             *

123          KK     W03BASIN
124          KM        BASIN BOUNDARY FROM 1990 TOPO
125          BA   1.971
126          LG    0.35    0.35    4.00    0.47      20
127          UI       0     145     146     415     653     907    1064    1233    1685    1257
128          UI     947     849     756     672     606     522     442     374     341     315
129          UI     263     217     186     167     159     119     113     107      71      72
130          UI      70      71      37      27      28      28      28      28      28      28
131          UI      27      29      27       0       0       0       0       0       0       0
             *
1                                          HEC-1 INPUT                                          PAGE  4

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

132          KK  W03W04ROUTE
133          KM        Cross-section: Side slopes and width based on aerial and topo
134          KM        Manning's N Value: natural desert wash w/ vegetation
135          RS       3    FLOW
136          RC   0.035   0.035   0.035   18417  0.0490    0.00
137          RX  100.00  140.00  180.00  210.00  235.00  305.00  345.00  385.00
138          RY  1511.0 1510.50 1510.00 1502.00 1502.10 1510.00 1511.00 1512.00
             *

139          KK     W04BASIN
140          KM        BASIN BOUNDARY FROM 1990 TOPO
141          BA   2.034
142          LG    0.35    0.35    4.60    0.34      10
143          UI       0     144     147     379     620     881    1032    1176    1561    1470
144          UI     998     876     788     702     637     566     477     407     357     335
145          UI     304     239     203     188     158     157     113     111     105      72
146          UI      71      71      71      40      28      28      27      28      28      28
147          UI      28      28      27      28       0       0       0       0       0       0
             *

148          KK   CPW04COMBINE
149          HC       2   4.005
             *

150          KK  W04W05ROUTE
151          KM        Cross-section: Estimated 3' deep and 4:1 side slopes
152          KM        width based on aerial / Manning's N Value: clean straight earth
153          RS       2    FLOW
154          RC   0.035   0.035   0.035    5298  0.0098    0.00
155          RX  100.00  120.00  140.00  160.00  174.00  214.00  234.00  254.00
156          RY  1313.0 1312.50 1312.00 1308.00 1308.10 1312.00 1312.50 1313.00
             *

157          KK     W05BASIN
158          KM        BASIN BOUNDARY FROM 1990 TOPO AND BEARDSELY CSR
159          BA   0.316
160          LG    0.35    0.35    4.25    0.42       0
161          UI       0      32      62     147     214     282     302     300     260     199
162          UI     153     119      90      67      54      40      32      22      22       9
163          UI       7       8       8       8       8       0       0       0       0       0
164          UI       0       0       0       0       0       0       0       0       0       0
165          UI       0       0       0       0       0       0       0       0       0       0
             *

166          KK   CPW05COMBINE
167          HC       3   5.793
             *

168          KK  DW05SEDIVERT
169          KM        North Inlet Channel Divert from L303M3LA.OUT model given to HDR by
170          KM        FCDMC 05062009
171          DT   DW05S     0.0     0.0
172          DI   600.0   800.0  1000.0  1200.0  1400.0  1600.0  2000.0  2400.0  2715.0  2800.0
173          DQ   105.0   163.0   361.0   498.0   640.0   792.0  1100.0  1437.0  1605.0  1630.0
             *
1                                          HEC-1 INPUT                                          PAGE  5

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

174          KK  W0512AROUTE
175          KM        White Tanks FRS#3 North Inlet Channel South
176          KM        Channel plans FCD Contract No 2007C021
177          KM        Cholla Wash
178          RS       3    FLOW
179          RC   0.050   0.030   0.050    5306  0.0083    0.00
180          RX  1010.0 1015.00 1020.00 1050.00 1100.00 1275.00 1580.00 1750.00
181          RY  1251.0 1249.00 1249.00 1245.00 1244.90 1250.00 1250.00 1254.00
             *

182          KK     W06BASIN
183          KM        BASIN BOUNDARY FROM 1990 TOPO
184          BA   0.707
185          LG    0.35    0.35    4.30    0.41      18
186          UI       0     103     362     675     987     837     576     461     363     257
187          UI     217     150     119      90      72      49      48      20      20      19
188          UI      20      20       0       0       0       0       0       0       0       0
189          UI       0       0       0       0       0       0       0       0       0       0
190          UI       0       0       0       0       0       0       0       0       0       0
             *

191          KK     W07BASIN
192          KM        BASIN BOUNDARY FROM 1990 TOPO
193          BA   0.312
194          LG    0.35    0.35    4.25    0.42      19
195          UI       0      65     253     428     510     316     236     171     126      89
196          UI      63      46      33      26      14      11      10      10       0       0
197          UI       0       0       0       0       0       0       0       0       0       0
198          UI       0       0       0       0       0       0       0       0       0       0
199          UI       0       0       0       0       0       0       0       0       0       0
             *

200          KK   CPW07COMBINE
201          HC       2   1.019
             *

202          KK  W07W08ROUTE
203          KM        Cross-section: Based on aerial and topo
204          KM        Manning's N Value: Natural Desert wash w/ vegetation
205          KM        N value modified to slow velocity
206          RS       1    FLOW
207          RC   0.045   0.040   0.045    5589  0.0796    0.00
208          RX  100.00  136.00  173.00  197.00  234.00  254.00  298.00  342.00
209          RY  2880.0 2865.00 2850.00 2840.00 2840.00 2850.00 2865.00 2880.00
             *

210          KK     W08BASIN
211          KM        BASIN BOUNDARY FROM 1990 TOPO
212          BA   0.446
213          LG    0.35    0.35    3.95    0.40      20
214          UI       0     156     587     941     577     413     262     183     117      78
215          UI      49      32      19      19      19       0       0       0       0       0
216          UI       0       0       0       0       0       0       0       0       0       0
217          UI       0       0       0       0       0       0       0       0       0       0
1                                          HEC-1 INPUT                                          PAGE  6

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

218          UI       0       0       0       0       0       0       0       0       0       0
             *

219          KK   CPW08COMBINE
220          HC       2   1.465
             *

221          KK     W09BASIN
222          KM        BASIN BOUNDARY FROM 1990 TOPO
223          BA   0.335
224          LG    0.35    0.35    3.95    0.40      20
225          UI       0     125     468     716     427     304     193     127      85      53
226          UI      37      19      14      15       0       0       0       0       0       0
227          UI       0       0       0       0       0       0       0       0       0       0
228          UI       0       0       0       0       0       0       0       0       0       0
229          UI       0       0       0       0       0       0       0       0       0       0
             *

230          KK   CPW09COMBINE
231          HC       2     1.8
             *

232          KK  W09W10ROUTE
233          KM        Cross-section: Based on aerial and topo
234          KM        Manning's N Value: Natural Desert wash w/ vegetation
235          KM        N value modified to slow velocity
236          RS       1    FLOW
237          RC   0.045   0.040   0.045   11134  0.0683    0.00
238          RX  100.00  137.00  172.00  192.00  220.00  230.00  284.00  338.00
239          RY  1990.0 1975.00 1960.00 1950.00 1950.00 1960.00 1975.00 1990.00
             *

240          KK     W10BASIN
241          KM        BASIN BOUNDARY FROM 1990 TOPO
242          BA   1.338
243          LG    0.35    0.35    3.95    0.40      20
244          UI       0     153     376     806    1108    1572    1334     920     794     647
245          UI     533     402     350     278     212     175     141     119      85      75
246          UI      75      29      30      30      29      30      29       0       0       0
247          UI       0       0       0       0       0       0       0       0       0       0
248          UI       0       0       0       0       0       0       0       0       0       0
             *

249          KK   CPW10COMBINE
250          HC       2   3.138
```

```
                   *

 251               KK     W11BASIN
 252               KM        BASIN BOUNDARY FROM 1990 TOPO
 253               BA   0.812
 254               LG    0.35    0.35    3.95    0.40      20
 255               UI       0     100     272     567     759    1098     696     556     469     375
 256               UI     285     236     190     141     116      92      77      52      48      39
 257               UI      20      19      19      19      19      20       0       0       0       0
 258               UI       0       0       0       0       0       0       0       0       0       0
1                                                   HEC-1 INPUT                                          PAGE  7

LINE               ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 259               UI       0       0       0       0       0       0       0       0       0       0
                   *

 260               KK   CPW11COMBINE
 261               HC       2    3.95
                   *

 262               KK  W11W12ROUTE
 263               KM        Cross-section: Based on aerial and topo
 264               KM        Manning's N Value: Natural Desert wash w/ vegetation
 265               RS       8     FLOW
 266               RC   0.045   0.035   0.045   21182  0.0205    0.00
 267               RX  100.00  110.30  290.50  304.40  319.20  330.60  344.60  569.70
 268               RY  1312.0 1310.00 1308.00 1306.00 1305.90 1308.00 1310.00 1312.00
                   *

 269               KK     W12BASIN
 270               KM        BASIN BOUNDARY FROM 1990 TOPO AND BEARDSELY CSR
 271               BA   1.868
 272               LG    0.34    0.34    4.60    0.34       3
 273               UI       0     125     126     289     490     706     847     961    1170    1474
 274               UI    1002     820     727     654     604     537     483     418     353     310
 275               UI     293     266     221     193     160     148     139     120      96      96
 276               UI      83      61      61      61      61      37      24      24      24      24
 277               UI      24      25      24      24      24      24      24       0       0       0
                   *

 278               KK  DW05SERETRIEVE
 279               KM        Flow traveling down North Inlet Channel
 280               DR   DW05S
                   *

 281               KK  W0512BROUTE
 282               KM        White Tanks FRS#3 North Inlet Channel South
 283               KM        Channel plans FCD Contract No 2007C021
 284               KM        N value modifeid to mimic slowing of velocity by drop structures
 285               RS       2     FLOW
 286               RC   0.035   0.035   0.035    5494  0.0170    0.00
 287               RX  100.00  120.00  135.00  165.00  220.00  300.00  315.00  379.00
 288               RY  1244.7 1239.65 1239.50 1232.00 1231.90 1239.50 1239.65 1255.65
                   *

 289               KK   CPW12COMBINE
 290               HC       4   11.61
                   *

 291               KK  W12W13ROUTE
 292               KM        From NIC South Channel Plans at Sta. 535+00
 293               RS       1     FLOW
 294               RC   0.032   0.032   0.032    2062  0.0051    0.00
 295               RX  100.00  120.00  162.50  205.00  355.00  397.50  440.00  460.00
 296               RY  1218.4 1218.18 1211.10 1203.98 1204.45 1211.53 1218.65 1218.85
                   *
1                                                   HEC-1 INPUT                                          PAGE  8

LINE               ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 297               KK     W13BASIN
 298               KM        BASIN BOUNDARY FROM 1990 TOPO AND BEARDSELY CSR
 299               BA   1.584
 300               LG    0.35    0.35    4.90    0.29       3
 301               UI       0     107     108     254     430     622     734     838    1035    1255
 302               UI     820     689     615     557     511     445     405     352     287     261
 303               UI     248     223     176     154     137     121     119      90      83      83
 304               UI      59      52      53      53      48      21      20      21      20      21
 305               UI      20      21      21      20      21      21       0       0       0       0
                   *

 306               KK   CPW13COMBINE
 307               HC       2  13.194
                   *

 308               KK  W13W16ROUTE
 309               KM        From NIC South Channel Plans
 310               KM        at Sta. 523+00
 311               RS       2     FLOW
 312               RC   0.032   0.032   0.032    6257  0.0051    0.00
 313               RX  100.00  115.00  162.00  209.10  359.10  435.90  465.00  480.00
 314               RY  1216.9 1216.77 1208.93 1201.09 1203.09 1215.09 1223.54 1223.69
                   *

 315               KK     W15BASIN
 316               KM        BASIN BOUNDARY FROM 1990 TOPO
 317               BA   1.227
 318               LG    0.35    0.35    4.55    0.35       0
 319               UI       0      98     112     315     498     652     757     975    1045     671
 320               UI     578     523     457     400     352     284     245     227     196     161
 321               UI     128     117     107      86      75      70      49      48      47      43
 322               UI      19      18      19      19      19      19      18      19      19       0
 323               UI       0       0       0       0       0       0       0       0       0       0
                   *

 324               KK     W14BASIN
 325               KM        BASIN BOUNDARY FROM 1990 TOPO
 326               BA   1.582
 327               LG    0.35    0.37    5.20    0.25       3
 328               UI       0     165     333     776    1104    1420    1804    1142     948     811
 329               UI     682     567     431     386     320     242     201     182     128     124
 330               UI      82      80      79      32      32      32      32      31      32      32
 331               UI       0       0       0       0       0       0       0       0       0       0
 332               UI       0       0       0       0       0       0       0       0       0       0
                   *

 333               KK  W14W15ROUTE
 334               KM        Cross-section: Based on aerial and topo
 335               KM        Manning's N Value: Natural Desert wash w/ vegetation
 336               RS       3     FLOW
 337               RC   0.035   0.035   0.035    7308  0.0104    0.00
 338               RX  100.00  130.00  150.00  184.00  210.00  226.00  246.00  276.00
 339               RY  1280.0 1276.00 1274.00 1270.00 1269.90 1274.00 1276.00 1280.00
                   *
1                                                   HEC-1 INPUT                                          PAGE  9

LINE               ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 340               KK   CPW15COMBINE
 341               HC       2   2.809
                   *

 342               KK  W15W16ROUTE
 343               KM        Cross-section: Based on aerial and topo
 344               KM        Manning's N Value: Natural Desert wash w/ vegetation
 345               RS       1     FLOW
 346               RC   0.035   0.035   0.035    2750  0.0087    0.00
 347               RX  100.00  135.00  232.00  328.00  360.00  498.00  635.00  735.00
 348               RY  1202.0 1200.00 1199.00 1198.00 1197.90 1199.00 1200.00 1202.00
                   *

 349               KK     W16BASIN
 350               KM        BASIN BOUNDARY FROM BEARDSLEY CSR, THE FRS#4 AND 1990 TOPO
 351               BA   0.530
 352               LG    0.22    0.22    4.55    0.33       0
 353               UI       0      61     148     318     464     562     575     509     384     282
 354               UI     211     157     115      87      65      42      42      15      14      15
 355               UI      15      15       0       0       0       0       0       0       0       0
 356               UI       0       0       0       0       0       0       0       0       0       0
 357               UI       0       0       0       0       0       0       0       0       0       0
                   *

 358               KK   CPW16COMBINE
 359               HC       3  16.534
                   *

 360               KK  W16W20ROUTE
 361               KM        Cross-section: Based on aerial and topo
 362               KM        Manning's N Value: clean earth; straight
 363               RS       1     FLOW
 364               RC   0.022   0.022   0.022    3633  0.0130    0.00
 365               RX  100.00  113.00  127.00  136.00  245.00  272.00  318.00  384.00
 366               RY  1186.0 1184.00 1182.00 1180.00 1179.90 1182.00 1184.00 1186.00
                   *

 367               KK     W18BASIN
 368               KM        BASIN BOUNDARY FROM 1990 TOPO
 369               BA   1.260
 370               LG    0.35    0.35    4.40    0.38       8
 371               UI       0      38      38      38      38      38      99     112     147     168
 372               UI     200     230     242     261     278     296     307     348     390     440
 373               UI     461     337     285     264     241     228     223     213     202     195
 374               UI     185     177     171     161     152     148     137     130     119     110
 375               UI     100      97      93      90      89      86      79      81      68      62
                   *

 376               KK     W17BASIN
 377               KM        BASIN BOUNDARY FROM 1990 TOPO
 378               BA   1.497
 379               LG    0.35    0.35    4.30    0.41      18
 380               UI       0     169     396     865    1197    1639    1571    1038     892     737
 381               UI     607     469     398     324     247     201     173     131     110      82
1                                                   HEC-1 INPUT                                          PAGE 10

LINE               ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 382               UI      83      52      32      33      32      32      33      32       0       0
```

```
383          UI       0       0       0       0       0       0       0       0       0       0
384          UI       0       0       0       0       0       0       0       0       0       0
             *

385          KK  W17W18ROUTE
386          KM        Cross-section: Based on aerial and topo
387          KM        Manning's N Value: natural desert wash w/ vegetation
388          KM        and heavy vegetation
389          RS       2    FLOW
390          RC   0.045   0.035   0.045    8559  0.0257    0.00
391          RX  100.00  140.00  150.00  156.00  194.00  216.00  255.00  342.00
392          RY  1302.0 1300.00 1298.00 1296.00 1295.90 1298.00 1300.00 1302.00
             *

393          KK   CPW18COMBINE
394          HC       2   2.757
             *

395          KK  W18W20ROUTE
396          KM        Cross-section: Estimated 3' deep, side slopes and width based
397          KM        on aerial / Manning's N Value: natural desert wash w/ vegetation
398          RS       5    FLOW
399          RC   0.035   0.035   0.035    6914  0.0058    0.00
400          RX  100.00  155.00  170.00  210.00  216.00  256.00  276.00  336.00
401          RY  1249.0 1248.25 1248.00 1245.00 1245.10 1248.00 1248.25 1249.00
             *

402          KK     W19BASIN
403          KM        BASIN BOUNDARY FROM VERRADO DEVELOPED CONDITIONS DRAINAGE PLAN
404          KM        WOOD/PATEL (2006) MODIFIED SLIGHTLY TO MATCH 1990 2' CI TOPO
405          BA   1.158
406          LG    0.35    0.35    3.88    0.42      20
407          UI       0     241     939    1587    1896    1172     876     636     467     328
408          UI     236     172     119      99      51      39      39      39       0       0
409          UI       0       0       0       0       0       0       0       0       0       0
410          UI       0       0       0       0       0       0       0       0       0       0
411          UI       0       0       0       0       0       0       0       0       0       0
             *

412          KK   SRW19STORAGE
413          KM        Master Drainage Plan for the Caterpillar Property (Basin #16)
414          KO
415          RS       1    STOR
416          SV            1.00   31.00  114.00  270.00  502.00  807.00 1319.00 1388.00 1460.00
417          SQ                                                                          135.00
418          SE  1198.0 1200.00 1210.00 1220.00 1230.00 1240.00 1250.00 1260.00 1261.00 1262.00
419          ST
             *
```

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1                                          HEC-1 INPUT                                          PAGE 11

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

420          KK  W19W20ROUTE
421          KM        Cross-section: Estimated 4' deep and 3:1 side slopes, width based
422          KM        on aerial / Manning's N Value: earth with sparse treese and shrubs
423          RS       1    FLOW
424          RC   0.032   0.032   0.032    3790  0.0158    0.00
425          RX  100.00  120.00  140.00  152.00  158.00  170.00  190.00  210.00
426          RY  1240.5 1240.25 1240.00 1236.00 1236.00 1240.00 1240.25 1240.50
             *

427          KK     W20BASIN
428          KM        BASIN BOUNDARY FROM WHITE TANKS #4 FRS, S-S-D CURVES
429          KM        FROM JAN 2009 FCDMC, AND FROM 1990 TOPO
430          BA   1.137
431          LG    0.29    0.29    4.10    0.44       0
432          UI       0     104     165     390     618     777     969    1101     712     596
433          UI     525     458     389     315     265     233     199     157     131     115
434          UI      98.      80      71      51      50      51      26      19      20      20
435          UI      20      20      20      20      20       0       0       0       0       0
436          UI       0       0       0       0       0       0       0       0       0       0
             *

437          KK   CPW20COMBINE
438          HC       4  21.586
             *

439          KK   SRW20 STORAGE
440          KM   STAGE-STORAGE-DISCHARGE CURVE FROM URS DESIGN OF FRS#3 OUTLET STRUCTURE
441          KM   THE DISCHARGE INCLUDING OUTFLOW FROM PRINCIPAL AND EMERGENCY SPILLWAY,
442          KM   AS WELL AS INFILTRATION
443          RS       1    STOR      -1
444          SV    44.8     388     585     846    1002    2045    3218    3557    4693    6510
445          SQ    0.02    0.17     4.5     187     203     276     330    2936   24545   70439
446          SE    1188    1198    1200    1202    1203    1208    1212    1213    1216    1220
             *

447          KK   OUTFL
448          KM   SEPRATE OUTFLOW FROM INFILTRATION
             * KO      1
449          ZW   A=WT B=FRS3 C=FLOW
450          DT    INFL
451          DI       0     4.5      86     203     330    2936   24545   70439
452          DQ       0     4.5      10      22      73      79      96     121
             453          ZZ
1
                    SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
 LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

  40          L21
                .
                .
  52            .------->    RL21
  50       DL21RE
                V
                V
  55       L21L22
                .
                .
  62            .         L22
                .           .
                .           .
  74            .           .------->    RL22
  72            .      DL22RE
                .           .
                .           .
  77       CPL22............
                V
                V
  79       L22W01
                .
                .
  86            .         W01
                .           .
                .           .
  95       CPW01............
                V
                V
  97       W01W02
                .
                .
 105            .         W02
                .           .
                .           .
 115       CPW02............
                V
                V
 117       W02W05
                .
                .
 123            .         W03
                .           V
                .           V
 132            .      W03W04
                .           .
                .           .
 139            .           .         W04
                .           .           .
                .           .           .
 148            .      CPW04............
                .           V
                .           V
 150            .      W04W05
                .           .
                .           .
 157            .           .         W05
                .           .           .
                .           .           .
 166       CPW05........................
                .
                .
 171            .------->   DW05S
 168       DW05SE
                V
                V
 174       W0512A
                .
                .
 182            .         W06
                .           .
                .           .
 191            .           .         W07
                .           .           .
                .           .           .
 200            .      CPW07............
                .           V
                .           V
 202            .      W07W08
                .           .
                .           .
 210            .           .         W08
                .           .           .
                .           .           .
 219            .      CPW08............
                .           .
                .           .
```

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221          .          .        W09
             .          .          .
             .          .          .
230          .      CPW09............
             .          V
             .          V
232          .      W09W10
             .          .
             .          .
240          .          .        W10
             .          .          .
             .          .          .
249          .      CPW10............
             .          .
             .          .
251          .          .        W11
             .          .          .
             .          .          .
260          .      CPW11............
             .          V
             .          V
262          .      W11W12
             .          .
             .          .
269          .          .        W12
             .          .          .
             .          .          .
280          .          .          .          .<-------   DW05S
278          .          .          .     DW05SE
             .          .          .          V
             .          .          .          V
281          .          .          .     W0512B
             .          .          .          .
             .          .          .          .
289      CPW12...................................
             V
             V
291      W12W13
             .
             .
297          .      W13
             .          .
             .          .
306      CPW13............
             V
             V
308      W13W16
             .
             .
315          .      W15
             .          .
             .          .
324          .          .        W14
             .          .          V
             .          .          V
333          .          .     W14W15
             .          .          .
             .          .          .
340          .      CPW15............
             .          V
             .          V
342          .      W15W16
             .          .
             .          .
349          .          .        W16
             .          .          .
             .          .          .
358      CPW16........................
             V
             V
360      W16W20
             .
             .
367          .      W18
             .          .
             .          .
376          .          .        W17
             .          .          V
             .          .          V
385          .          .     W17W18
             .          .          .
             .          .          .
393          .      CPW18............
             .          V
             .          V
395          .      W18W20
             .          .
             .          .
402          .          .        W19
             .          .          V
             .          .          V
412          .          .      SRW19
             .          .          V
             .          .          V
420          .          .     W19W20
             .          .          .
             .          .          .
427          .          .        W20
             .          .          .
             .          .          .
437      CPW20.....................................
             V
             V
439      SRW20
             .
             .
450          .-------->    INFL
447      OUTFL
```

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	L21	195.	13.25	57.	14.	5.	.52		
+	DIVERSION TO	RL21	195.	13.25	57.	14.	5.	.52		
+	HYDROGRAPH AT	DL21RE	0.	.00	0.	0.	0.	.52		
+	ROUTED TO	L21L22	0.	.00	0.	0.	0.	.52		
+	HYDROGRAPH AT	L22	175.	12.92	38.	10.	3.	.36		
+	DIVERSION TO	RL22	175.	12.92	31.	8.	3.	.36		
+	HYDROGRAPH AT	DL22RE	56.	13.75	7.	2.	1.	.36		
+	2 COMBINED AT	CPL22	56.	13.75	7.	2.	1.	.89		
+	ROUTED TO	L22W01	41.	14.08	7.	2.	1.	.89		
+	HYDROGRAPH AT	W01	252.	12.25	21.	5.	2.	.19		
+	2 COMBINED AT	CPW01	249.	12.25	27.	7.	2.	1.08		
+	ROUTED TO	W01W02	196.	12.33	27.	7.	2.	1.08		
+	HYDROGRAPH AT	W02	461.	12.33	44.	11.	4.	.39		
+	2 COMBINED AT	CPW02	652.	12.33	70.	18.	6.	1.47		
+	ROUTED TO	W02W05	608.	12.42	70.	18.	6.	1.47		
+	HYDROGRAPH AT	W03	1384.	12.58	267.	79.	26.	1.97		
+	ROUTED TO	W03W04	1195.	12.83	267.	79.	26.	1.97		
+	HYDROGRAPH AT	W04	1411.	12.58	257.	70.	23.	2.03		
+	2 COMBINED AT	CPW04	2341.	12.67	520.	148.	50.	4.01		
+	ROUTED TO	W04W05	2211.	12.83	520.	148.	50.	4.01		
+	HYDROGRAPH AT	W05	269.	12.42	32.	8.	3.	.32		
+	3 COMBINED AT	CPW05	2517.	12.75	619.	173.	58.	5.79		
+	DIVERSION TO	DW05S	1499.	12.75	310.	96.	32.	5.79		
+	HYDROGRAPH AT	DW05SE	1018.	12.75	309.	77.	26.	5.79		

```
                ROUTED TO
+                   W0512A    990.  12.92    309.    77.    26.   5.79
                HYDROGRAPH AT
+                      W06    817.  12.25     97.    28.     9.    .71
                HYDROGRAPH AT
+                      W07    403.  12.25     43.    13.     4.    .31
                2 COMBINED AT
+                    CPW07   1215.  12.25    139.    40.    13.   1.02
                ROUTED TO
+                   W07W08   1094.  12.33    139.    40.    13.   1.02
                HYDROGRAPH AT
+                      W08    684.  12.17     64.    19.     6.    .45
                2 COMBINED AT
+                    CPW08   1602.  12.25    202.    59.    20.   1.47
                HYDROGRAPH AT
+                      W09    522.  12.17     48.    14.     5.    .34
                2 COMBINED AT
+                    CPW09   2060.  12.25    250.    73.    24.   1.80
                ROUTED TO
+                   W09W10   1758.  12.33    250.    73.    24.   1.80
                HYDROGRAPH AT
+                      W10   1364.  12.33    191.    56.    19.   1.34
                2 COMBINED AT
+                    CPW10   3107.  12.33    438.   128.    43.   3.14
                HYDROGRAPH AT
+                      W11    864.  12.33    116.    34.    11.    .81
                2 COMBINED AT
+                    CPW11   3956.  12.33    553.   161.    54.   3.95
                ROUTED TO
+                   W11W12   2825.  13.00    553.   161.    54.   3.95
                HYDROGRAPH AT
+                      W12   1185.  12.58    214.    55.    18.   1.87
                HYDROGRAPH AT
+                    DW05SE   1499.  12.75    310.    96.    32.   5.79
                ROUTED TO
+                   W0512B   1463.  12.92    310.    96.    32.   5.79
                4 COMBINED AT
+                    CPW12   5800.  13.00   1359.   382.   128.  11.61
                ROUTED TO
+                   W12W13   5771.  13.00   1358.   382.   128.  11.61
                HYDROGRAPH AT
+                      W13   1054.  12.58    188.    48.    16.   1.58
                2 COMBINED AT
+                    CPW13   6266.  13.00   1525.   425.   142.  13.19
                ROUTED TO
+                   W13W16   6114.  13.17   1524.   425.   142.  13.19
                HYDROGRAPH AT
+                      W15    875.  12.50    132.    33.    11.   1.23
                HYDROGRAPH AT
+                      W14   1482.  12.33    193.    50.    17.   1.58
                ROUTED TO
+                   W14W15   1336.  12.58    192.    50.    17.   1.58
                2 COMBINED AT
+                    CPW15   2167.  12.58    322.    82.    27.   2.81
                ROUTED TO
+                   W15W16   1933.  12.67    322.    82.    27.   2.81
                HYDROGRAPH AT
+                      W16    581.  12.33     66.    17.     6.    .53
                3 COMBINED AT
+                    CPW16   7151.  13.08   1864.   511.   171.  16.53
                ROUTED TO
+                   W16W20   7137.  13.08   1864.   511.   171.  16.53
                HYDROGRAPH AT
+                      W18    430.  13.50    134.    36.    12.   1.26
                HYDROGRAPH AT
+                      W17   1456.  12.33    203.    59.    20.   1.50
                ROUTED TO
+                   W17W18   1293.  12.50    203.    59.    20.   1.50
                2 COMBINED AT
+                    CPW18   1431.  12.50    336.    95.    32.   2.76
                ROUTED TO
+                   W18W20   1249.  12.92    336.    95.    32.   2.76
                HYDROGRAPH AT
+                      W19   1508.  12.25    163.    48.    16.   1.16
                ROUTED TO
+                    SRW19      0.    .00      0.     0.     0.   1.16
                ROUTED TO
+                   W19W20      0.    .00      0.     0.     0.   1.16
                HYDROGRAPH AT
+                      W20    889.  12.42    121.    30.    10.   1.14
                4 COMBINED AT
+                    CPW20   8283.  13.08   2247.   616.   206.  21.59
                ROUTED TO
+                    SRW20    212.  17.00    212.   204.   113.  21.59
                DIVERSION TO
+                     INFL     26.  17.00     25.    23.    14.  21.59
                HYDROGRAPH AT
+                    OUTFL    187.  17.00    186.   180.    99.  21.59
1                   SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION    SRW19
                 (PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED  DURING BREACH FORMATION)

PLAN  1 ..............                  INITIAL VALUE     SPILLWAY CREST     TOP OF DAM
                              ELEVATION       1198.00               .00            .00
                              STORAGE              0.                0.             0.
                              OUTFLOW              0.                0.             0.

                      RATIO    MAXIMUM     MAXIMUM    MAXIMUM    MAXIMUM    DURATION     TIME OF     TIME OF
                        OF    RESERVOIR    DEPTH     STORAGE    OUTFLOW    OVER TOP    MAX OUTFLOW  FAILURE
                       PMF    W.S.ELEV    OVER DAM    AC-FT       CFS        HOURS        HOURS      HOURS

                      1.00    1218.37     1218.37      100.        0.      166.58          .00        .00

PLAN  2 ..............                  INITIAL VALUE     SPILLWAY CREST     TOP OF DAM
                              ELEVATION       1198.00               .00            .00
                              STORAGE              0.                0.             0.
                              OUTFLOW              0.                0.             0.

                      RATIO    MAXIMUM     MAXIMUM    MAXIMUM    MAXIMUM    DURATION     TIME OF     TIME OF
                        OF    RESERVOIR    DEPTH     STORAGE    OUTFLOW    OVER TOP    MAX OUTFLOW  FAILURE
                       PMF    W.S.ELEV    OVER DAM    AC-FT       CFS        HOURS        HOURS      HOURS

                      1.00    1217.53     1217.53       94.        0.      166.58          .00        .00

PLAN  3 ..............                  INITIAL VALUE     SPILLWAY CREST     TOP OF DAM
                              ELEVATION       1198.00               .00            .00
                              STORAGE              0.                0.             0.
                              OUTFLOW              0.                0.             0.

                      RATIO    MAXIMUM     MAXIMUM    MAXIMUM    MAXIMUM    DURATION     TIME OF     TIME OF
                        OF    RESERVOIR    DEPTH     STORAGE    OUTFLOW    OVER TOP    MAX OUTFLOW  FAILURE
                       PMF    W.S.ELEV    OVER DAM    AC-FT       CFS        HOURS        HOURS      HOURS

                      1.00    1216.69     1216.69       87.        0.      166.58          .00        .00

*** NORMAL END OF HEC-1 ***
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A.10 Hydrological Information from the FRS3 Phase I Design Report

TABLE 10-1
Reservoir Routing Results

Storm Event	Inflow to White Tanks FRS No. 3		Outflow from White Tanks FRS No. 3 (Interim Condition)						Outflow from White Tanks FRS No. 3 (Future Condition - Principal Spillway Open)						Outflow from White Tanks FRS No. 3 (Future Condition - Principal Spillway Closed)					
			NRCS Criteria			ADWR Criteria			NRCS Criteria			ADWR Criteria			NRCS Criteria			ADWR Criteria		
	Precipitation (inches)	Peak Inflow (cfs)	Antecedent Reservoir Condition (ARC)	Peak Outflow (cfs)	Maximum Reservoir Elevation (NAVD 88) (feet)	Antecedent Reservoir Condition (ARC)	Peak Outflow (cfs)	Maximum Reservoir Elevation (NAVD 88) (feet)	Antecedent Reservoir Condition (ARC)	Peak Outflow (cfs)	Maximum Reservoir Elevation (NAVD 88) (feet)	Antecedent Reservoir Condition (ARC)	Peak Outflow (cfs)	Maximum Reservoir Elevation (NAVD 88) (feet)	Antecedent Reservoir Condition (ARC)	Peak Outflow (cfs)	Maximum Reservoir Elevation (NAVD 88) (feet)	Antecedent Reservoir Condition (ARC)	Peak Outflow (cfs)	Maximum Reservoir Elevation (NAVD 88) (feet)
6-hr General PMP	8.80	35,792	1,202.1	15,136	1,214.9	NR[5]	NR	NR	1,200.0[4]	14,678	1,214.9	NR	NR	NR	1,204.8	15,970	1215.1	NR	NR	NR
12-hr General PMP	11.00	33,378	1,202.1	17,853	1,215.3	NR	NR	NR	1,200.0	17,229	1,215.2	NR	NR	NR	1,204.8	19,022	1215.4	NR	NR	NR
18-hr General PMP	12.20	27,450	1,202.1	21,915	1,215.7	NR	NR	NR	1,200.0	21,338	1,215.6	NR	NR	NR	1,204.8	22,744	1215.8	NR	NR	NR
24-hr General PMP	12.90	24,171	1,202.1	20,635	1,215.6	NR	NR	NR	1,200.0	20,306	1,215.5	NR	NR	NR	1,204.8	21,065	1215.6	NR	NR	NR
48-hr General PMP	15.00	32,262	1,202.1	21,667	1,215.7	NR	NR	NR	1,200.0	20,577	1,215.6	NR	NR	NR	1,204.8	23,461	1215.9	NR	NR	NR
72-hr General PMP	15.80	32,763	1,202.1	24,613	1,216.0	1,197.0	22,757	1,215.8	1,200.0	23,170	1,215.9	1,200.0	23,230	1,215.9	1,204.8	26,054	1216.2	1,199.2	23,504	1,215.9
6-hr Local PMP	12.70	68,290	1,202.1	25,823	1,216.2	1,197.0	22,710	1,215.8	1,200.0	24,207	1,216.0	1,200.0	24,169	1,216.0	1,204.8	28,968	1,216.5	1,199.2	23,712	1,215.9
ESH	5.29	23,556	1,202.1	4,986	1,213.4	-	-	-	1,200.0	3,912	1,213.2	NR	NR	NR	1204.8	6,535	1,213.7	NR	NR	NR
100-year 10-Day	6.40[1]	2,179	1,197.0	58.3[3]	1206.3	NR	NR	NR	1,200.0	216	1,206.1	NR	NR	NR	1199.2	48.2[3]	1207.6	NR	NR	NR
Back-To-Back 100-year 10-day storms	6.40	2,179	1,205.1[2]	72.7[3]	1209.2	NR	NR	NR	NR	NR	NR	NR	NR	NR	1206.9[2]	67.5[3]	1210.8	NR	NR	NR

Notes:

1) The TR-20 model for the 100-year, 10-day storm events is set up different from the models for the other storm events. Due to the extended duration of the storm, the runoff depth of 1.64 inches is input to the model to reflect the total anticipated runoff.
2) The ARC for the second 100-year 10-day storm is based upon the reservoir elevation at the end of 10th day of the reservoir routing of first 100-year 10-day storm.
3) The peak outflow for 100-year 10-day and Back-Back 100-year 10-day storms reflects the infiltration amount only.
4) The ARC Elevation of:

   1197.0 ft corresponds to the invert level of the lowest outlet work,

   1199.2 ft corresponds to the100-year sediment pool level (500 acre-feet of sediment storage), and

   1200.0 ft corresponds to the crest elevation of the principal spillway.
5) NR stands for Not Required.
6) The water surface elevations shown in **BOLD** indicate the elevations used for design.

White Tanks FRS No. 3
Principal Spillway (48 inch) - Flow Capacity

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	outside pipe diameter (ft)	N/A											
2	pipe wall thickness (in)	N/A											
3	inside pipe diameter (ft)	4.00											
4	length (ft)	165											
5	pipe slope (ft/ft)	0.006											
6	outlet invert elevation (ft)	1190											
7	pipe upturn at inlet (ft)	2											
8	inlet invert elevation (ft)	1200											
9	Hazen-Williams Coefficient (C	130	smooth, concrete pipe										
10	C_b	0.6											
11	Inside Length of Riser	12.33											
12	Conduit Area	12.56											
13													
14	Weir Flow												
15	water elevation at inlet	depth over weir	Inlet Control, Q										
16	(ft)	(ft)	(cfs)										
17	1201	1.0	76.4										
18	1202	2.0	216.2										
19													
20													
21													
22	Pipe Flow												
23	headwater depth (h_1)	Water Elevation at inlet (z_1)	Tailwater Depth, h2	Water Elevation at Outlet (z_2)	Water Surface Elevation Difference (z_1-z_2)	Entrance loss coeff.	Exit loss coeff.	velocity	Minor Loses+Major Frictional Loses	Outlet Control, Q	Weir Flow	Pipe Flow (inlet Control), Q	Estimated Principal Spillway Capacity
24	(ft)	(ft)	(ft)	(ft)	(feet)			(fps)	(feet)	(cfs)	(cfs)	(cfs)	(cfs)
25	1.0	1201.0	0	1194.00	7.00	1.00	1.0	13.3	7.00	168	76	160	76
26	2.0	1202.0	0	1194.00	8.00	1.00	1.0	14.3	8.00	179	216	171	171
27	3.0	1203.0	0	1194.00	9.00	1.00	1.0	15.2	9.00	190	NA	181	181
28	4.0	1204.0	0	1194.00	10.00	1.00	1.0	16.0	10.00	201	NA	191	191
29	5.0	1205.0	0	1194.00	11.00	1.00	1.0	16.8	11.00	211	NA	201	201
30	6.0	1206.0	0	1194.00	12.00	1.00	1.0	17.6	12.00	220	NA	209	209
31	7.0	1207.0	0	1194.00	13.00	1.00	1.0	18.3	13.00	230	NA	218	218
32	8.0	1208.0	0	1194.00	14.00	1.00	1.0	19.0	14.00	238	NA	226	226
33	9.0	1209.0	0	1194.00	15.00	1.00	1.0	19.7	15.00	247	NA	234	234
34	10.0	1210.0	0	1194.00	16.00	1.00	1.0	20.3	16.00	255	NA	242	242
35	11.0	1211.0	0	1194.00	17.00	1.00	1.0	20.9	17.00	263	NA	249	249
36	12.0	1212.0	0	1194.00	18.00	1.00	1.0	21.6	18.00	271	NA	257	257
37	13.0	1213.0	0	1194.00	19.00	1.00	1.0	22.2	19.00	278	NA	264	264
38	14.0	1214.0	0	1194.00	20.00	1.00	1.0	22.7	20.00	286	NA	270	270
39	15.0	1215.0	0	1194.00	21.00	1.00	1.0	23.3	21.00	293	NA	277	277
40	16.0	1216.0	0	1194.00	22.00	1.00	1.0	23.9	22.00	300	NA	284	284
41	17.0	1217.0	0	1194.00	23.00	1.00	1.0	24.4	23.00	307	NA	290	290
42	18.0	1218.0	0	1194.00	24.00	1.00	1.0	25.0	24.00	313	NA	296	296
43	19.0	1219.0	0	1194.00	25.00	1.00	1.0	25.5	25.00	320	NA	302	302
44	20.0	1220.0	0	1194.00	26.00	1.00	1.0	26.0	26.00	326	NA	308	308

White Tanks FRS No. 3
Gated Outlet - 48 inch - Flow Capacity

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	outside pipe diameter (ft)	4											
2	pipe wall thickness (in)	0.25											
3	inside pipe diameter (ft)	3.96											
4	length (ft)	165											
5	pipe slope (ft/ft)	0.006											
6	outlet invert elevation (ft)	1190											
7	pipe upturn at inlet (ft)	2											
8	inlet invert elevation (ft)	1197											
9	Hazen-Williams Coefficient (C_h)	130	smooth, concrete pipe										
10	Manning's Roughness (n)	0.012	all pipes with smooth interior (p.102 of Modern Sewer Design)										
11	**Pipe Flowing Partially Full Condition**												
12													
13				on page 100 of Modern Sewer Design (Please See Attached Pages 8-10).					Using Manning's Formula		Inlet control flow was estimated using Culvert Master. Assumes minimal tailwater effects.		
14	water elevation at inlet	flow depth in pipe	depth/ diameter (y/D)	A/D^2	R/D	T/D	Flow Area, A	Hydraulic Radius, R	Top Width, T	Flow velocity (V_1)	Outlet Control , Q	Inlet Control , Q	pipe flow
15	(ft)	(ft)					(sq. ft)	(feet)	(feet)	(ft/sec)			(cfs)
16	1198	1.0	0.25	0.154	0.147	0.866	2.413	0.582	3.4	3.7	9	7	7
17	1199	2.0	0.51	0.403	0.253	1.000	6.314	1.001	4.0	6.4	40	24	24
18	1200	3.0	0.76	0.640	0.302	0.854	10.028	1.195	3.4	7.6	77	47	47
19													
20													
21	**Pipe-Flowing-Full Condition**												
22							Using Bernoulli's Equation						
23	water elevation at inlet (z_1)	headwater depth, h1	tailwater depth, h2	tailwater elevation (z_2)	Water surface elevation difference (z_1-z_2)	Entrance loss coeff.	Exit loss coeff.	Velocity (V)	Frictional Loses + Minor Loses	Outlet Control, Q	Inlet Control , Q	Gated outlet pipe flow	
24	(ft)	(ft)	(ft)	(ft)				(fps)	(feet)	(cfs)	(cfs)	(cfs)	
25	1201	0.04	0	1193.96	7.04	1.00	1.0	13.4	7.04	165	87	87	
26	1202	1.04	0	1193.96	8.04	1.00	1.0	14.3	8.04	176	106	106	
27	1203	2.04	0	1193.96	9.04	1.00	1.0	15.2	9.04	187	123	123	
28	1204	3.04	0	1193.96	10.04	1.00	1.0	16.0	10.04	197	137	137	
29	1205	4.04	0	1193.96	11.04	1.00	1.0	16.8	11.04	207	150	150	
30	1206	5.04	0	1193.96	12.04	1.00	1.0	17.6	12.04	216	162	162	
31	1207	6.04	0	1193.96	13.04	1.00	1.0	18.3	13.04	225	173	173	
32	1208	7.04	0	1193.96	14.04	1.00	1.0	19.0	14.04	234	184	184	
33	1209	8.04	0	1193.96	15.04	1.00	1.0	19.7	15.04	242	194	194	
34	1210	9.04	0	1193.96	16.04	1.00	1.0	20.3	16.04	250	203	203	
35	1211	10.04	0	1193.96	17.04	1.00	1.0	20.9	17.04	258	212	212	
36	1212	11.04	0	1193.96	18.04	1.00	1.0	21.6	18.04	265	221	221	
37	1213	12.04	0	1193.96	19.04	1.00	1.0	22.2	19.04	273	229	229	
38	1214	13.04	0	1193.96	20.04	1.00	1.0	22.7	20.04	280	237	237	
39	1215	14.04	0	1193.96	21.04	1.00	1.0	23.3	21.04	287	245	245	
40	1216	15.04	0	1193.96	22.04	1.00	1.0	23.9	22.04	294	253	253	
41	1217	16.04	0	1193.96	23.04	1.00	1.0	24.4	23.04	300	260	260	
42	1218	17.04	0	1193.96	24.04	1.00	1.0	24.9	24.04	307	267	267	
43	1219	18.04	0	1193.96	25.04	1.00	1.0	25.5	25.04	313	274	274	
44	1220	19.04	0	1193.96	26.04	1.00	1.0	26.0	26.04	320	281	281	

APPENDIX B – CHANNEL HYDRAULICS

B.1 HEC-RAS MODEL - MIXED FLOW ANALYSIS WITH N=0.020

Note: Manning's n of 0.02 was applied for mixed flow analysis. Riprap is applied where velocoties are higher than 3 fps.

Required freeboard y=0.25(h+V2/2g), and 1-foot minimum for subcritical flow and 2-foot minimum for supercritical flow.

River Sta	Jackrabbit Trail Sta	Design Q (cfs)	Low Flow Elev (ft)	W.S. Elev (ft)	Bank Elevation (ft)	Flow Depth (ft)	Velocity (fps)	Froude Number	Required Free-board (ft)	Provided Free-board (ft)	Enough Free-board	Note
6200	10902	700	1082.12	1084.59	1088.12	2.47	7.95	1.01	2.00	3.53	YES	Concrete Channel
6550	11252	700	1083.13	1084.34	1089.13	1.21	15.11	2.50	2.00	4.79	YES	
6570	11272	700	1083.15	1086.35	1089.15	3.20	11.16	1.11	2.00	2.80	YES	
Culvert (Palm Ln)												
6663.2	11365	700	1083.60	1086.38	1091.60	2.78	15.68	1.66	2.00	5.22	YES	Concrete Drop Inlet
6673.2	11376	700	1084.60	1088.49	1092.60	3.89	11.23	1.01	2.00	4.11	YES	
6700	11402	700	1084.63	1090.55	1092.63	5.92	2.39	0.22	1.50	2.08	YES	
6800	11502	700	1084.73	1090.56	1092.73	5.83	2.70	0.25	1.49	2.17	YES	
6930	11632	700	1084.86	1090.58	1092.86	5.72	2.88	0.27	1.46	2.28	YES	Riprap
6945	11647	700	1084.87	1090.55	1092.87	5.68	3.43	0.27	1.47	2.32	YES	
6946	11648	700	1084.87	1090.60	1092.87	5.73	3.01	0.22	1.47	2.27	YES	Concrete Drop Structure
6976	11678	700	1084.90	1086.83	1092.90	1.93	20.11	2.55	2.05	6.07	YES	
6982	11684	700	1084.90	1087.40	1092.90	2.50	19.46	2.43	2.10	5.50	YES	
7000	11702	700	1087.90	1092.00	1095.90	4.10	10.76	1.00	2.00	3.90	YES	
7030	11732	700	1087.93	1093.88	1095.93	5.95	2.66	0.25	1.51	2.05	YES	Riprap
7150	11852	700	1088.05	1093.90	1096.05	5.85	2.74	0.25	1.49	2.15	YES	
7306	12008	700	1088.21	1093.93	1096.21	5.72	2.87	0.27	1.46	2.28	YES	Riprap
7321	12023	700	1088.22	1093.91	1096.22	5.69	3.43	0.27	1.47	2.31	YES	
7322	12024	700	1088.22	1093.95	1096.22	5.73	3.01	0.22	1.47	2.27	YES	Concrete Drop Structure
7352	12054	700	1088.25	1090.18	1096.25	1.93	20.11	2.55	2.05	6.07	YES	
7358	12060	700	1088.25	1090.75	1096.25	2.50	19.46	2.43	2.10	5.50	YES	
7376	12078	700	1091.25	1095.36	1099.25	4.11	10.75	1.00	2.00	3.89	YES	
7425	12127	700	1091.30	1097.23	1099.30	5.93	2.73	0.25	1.51	2.07	YES	Riprap
7700	12402	700	1091.58	1097.29	1099.58	5.71	2.90	0.27	1.46	2.29	YES	
7876	12578	700	1091.76	1097.36	1099.76	5.60	2.76	0.26	1.43	2.40	YES	
7885	12587	700	1091.76	1097.36	1099.76	5.60	2.77	0.22	1.43	2.40	YES	Riprap
7886	12588	700	1091.76	1097.39	1099.76	5.63	2.40	0.18	1.43	2.37	YES	Concrete Apron
7907	12609	700	1091.88	1094.75	1099.88	2.87	15.19	1.58	2.00	5.13	YES	
Culvert (Encanto Ave)												
7960	12662	700	1093.14	1095.98	1101.50	2.84	15.37	1.61	2.00	5.52	YES	Concrete Drop Inlet
7970	12672	700	1094.03	1097.92	1102.03	3.89	11.23	1.01	2.00	4.11	YES	
8004	12706	700	1094.05	1099.97	1102.05	5.92	2.64	0.24	1.51	2.08	YES	Riprap
8150	12852	700	1094.19	1099.99	1102.19	5.80	2.83	0.26	1.48	2.20	YES	
8325	13027	700	1094.37	1100.03	1102.37	5.66	2.94	0.28	1.45	2.34	YES	Riprap
8339	13041	700	1094.38	1100.01	1102.38	5.63	3.47	0.28	1.45	2.37	YES	
8340	13042	700	1094.38	1100.05	1102.38	5.67	3.04	0.23	1.45	2.33	YES	Concrete
8370	13072	700	1094.41	1096.21	1102.41	1.80	21.57	2.83	2.26	6.20	YES	Drop Structure
8376	13078	700	1094.41	1096.76	1102.41	2.35	21.05	2.73	2.31	5.65	YES	
8400	13102	700	1098.41	1102.51	1106.41	4.10	10.76	1.00	2.00	3.90	YES	
8437	13139	700	1098.45	1104.38	1106.45	5.93	2.72	0.25	1.51	2.07	YES	Riprap
8600	13302	700	1098.61	1104.43	1106.61	5.82	2.64	0.25	1.48	2.18	YES	
8733	13435	700	1098.75	1104.45	1106.75	5.70	2.90	0.27	1.46	2.30	YES	Riprap
8748	13450	700	1098.76	1104.42	1106.76	5.66	3.44	0.27	1.46	2.34	YES	
8749	13451	700	1098.76	1104.47	1106.76	5.71	3.02	0.22	1.46	2.29	YES	Concrete Drop Structure
8779	13481	700	1098.79	1100.59	1106.79	1.80	21.57	2.83	2.26	6.20	YES	
8785	13487	700	1098.79	1101.14	1106.79	2.35	21.05	2.73	2.31	5.65	YES	
8809	13511	700	1102.79	1106.90	1110.79	4.11	10.75	1.00	2.00	3.89	YES	
8863	13565	700	1102.84	1108.77	1110.84	5.93	2.78	0.25	1.51	2.07	YES	Riprap
9000	13702	700	1102.98	1108.80	1110.98	5.82	2.82	0.26	1.49	2.18	YES	
9183	13885	700	1103.17	1108.85	1111.17	5.68	2.80	0.26	1.45	2.32	YES	Riprap
9192.8	13894	700	1103.23	1108.86	1111.23	5.63	2.76	0.22	1.44	2.37	YES	Concrete Apron
9193.8	13895	700	1103.23	1108.89	1111.23	5.66	2.39	0.18	1.44	2.34	YES	
9218.1	13920	700	1103.23	1108.09	1111.23	4.86	8.97	0.72	1.53	3.14	YES	
Culvert (Virginia Ave)												
9272.1	13974	700	1106.97	1112.11	1114.99	5.14	8.47	0.66	1.56	2.88	YES	Riprap
9299	14001	700	1106.99	1113.27	1114.99	6.28	2.20	0.19	1.59	1.72	YES	
9450	14152	700	1107.12	1113.27	1115.12	6.15	2.55	0.23	1.56	1.85	YES	
9608	14310	700	1107.27	1113.30	1115.27	6.03	2.66	0.24	1.53	1.97	YES	
9623	14317	700	1107.35	1113.27	1115.35	5.92	3.27	0.25	1.52	2.08	YES	Riprap
9624	14325	700	1107.35	1113.31	1115.35	5.96	2.89	0.21	1.52	2.04	YES	
9654	14356	700	1107.35	1109.36	1115.35	2.01	19.30	2.40	2.00	5.99	YES	Concrete Drop Structure
9660	14362	700	1107.35	1109.94	1115.35	2.59	18.58	2.27	2.00	5.41	YES	
9675	14377	700	1109.85	1113.95	1117.85	4.10	10.76	1.00	2.00	3.90	YES	
9728	14430	700	1109.87	1115.83	1117.87	5.96	2.79	0.25	1.52	2.04	YES	Riprap
9900	14602	700	1110.04	1115.88	1118.04	5.84	2.63	0.25	1.49	2.16	YES	
10048	14750	700	1110.19	1115.91	1118.19	5.72	2.84	0.27	1.46	2.28	YES	Riprap
10063	14765	700	1110.20	1115.88	1118.20	5.68	3.43	0.27	1.47	2.32	YES	
10064	14766	700	1110.20	1115.92	1118.20	5.72	3.01	0.22	1.47	2.28	YES	Concrete Drop Structure
10094	14796	700	1110.23	1112.03	1118.23	1.80	21.57	2.83	2.26	6.20	YES	
10100	14802	700	1110.23	1112.57	1118.23	2.34	21.05	2.73	2.31	5.66	YES	
10124	14826	700	1114.23	1118.34	1122.23	4.11	10.75	1.00	2.00	3.89	YES	
10154	14856	700	1114.26	1120.20	1122.26	5.94	2.67	0.25	1.51	2.06	YES	Riprap
10350	15052	700	1114.46	1120.25	1122.46	5.79	2.76	0.26	1.48	2.21	YES	
10500	15202	700	1114.61	1120.29	1122.61	5.68	2.80	0.26	1.45	2.32	YES	
10510	15211	700	1114.63	1120.30	1122.63	5.67	2.74	0.22	1.45	2.33	YES	Riprap
10511	15212	700	1114.71	1120.32	1122.71	5.61	2.41	0.18	1.43	2.39	YES	Concrete Apron
10535	15237	700	1114.71	1119.50	1122.71	4.79	9.10	0.73	1.52	3.21	YES	
Culvert (Thomas Rd)												
10599	15301	700	1118.17	1123.31	1126.20	5.14	8.47	0.66	1.56	2.89	YES	Riprap
10645	15347	700	1118.20	1124.48	1126.20	6.28	2.11	0.18	1.59	1.72	YES	
10800	15502	700	1118.35	1124.48	1126.35	6.13	2.46	0.23	1.56	1.87	YES	
11017	15719	700	1118.56	1124.52	1126.56	5.96	2.69	0.25	1.52	2.04	YES	Riprap
11032	15733	700	1118.59	1124.49	1126.59	5.90	3.29	0.26	1.52	2.10	YES	
11033	15734	700	1118.59	1124.53	1126.59	5.94	2.91	0.21	1.52	2.06	YES	Concrete

11063	15764	700	1118.61	1120.57	1126.61	1.96	19.79	2.49	2.01	6.04	YES	Drop Structure
11069	15770	700	1118.61	1121.14	1126.61	2.53	19.12	2.37	2.05	5.47	YES	
11086	15787	700	1121.41	1125.51	1129.41	4.10	10.76	1.00	2.00	3.90	YES	
11133	15835	700	1121.45	1127.37	1129.45	5.92	2.86	0.26	1.51	2.08	YES	Riprap
11300	16002	700	1121.62	1127.42	1129.62	5.80	2.83	0.26	1.48	2.20	YES	
11484	16186	700	1121.80	1127.47	1129.80	5.67	2.94	0.28	1.45	2.33	YES	Riprap
11499	16201	700	1121.81	1127.44	1129.81	5.63	3.46	0.28	1.45	2.37	YES	
11500	16202	700	1121.81	1127.49	1129.81	5.68	3.04	0.22	1.46	2.32	YES	Concrete Drop Structure
11530	16232	700	1121.85	1123.65	1129.85	1.80	21.56	2.83	2.25	6.20	YES	
11536	16238	700	1121.85	1124.20	1129.85	2.35	21.05	2.73	2.31	5.65	YES	
11560	16262	700	1125.85	1129.96	1133.85	4.11	10.75	1.00	2.00	3.89	YES	
11590	16292	700	1125.88	1131.82	1133.88	5.94	2.73	0.25	1.51	2.06	YES	Riprap
11900	16602	700	1126.19	1131.90	1134.19	5.71	2.65	0.25	1.45	2.29	YES	
12164	16866	700	1126.45	1131.95	1134.45	5.50	3.08	0.29	1.41	2.50	YES	Riprap
12179	16881	700	1126.46	1131.93	1134.46	5.47	3.58	0.29	1.42	2.53	YES	
12180	16882	700	1126.46	1131.98	1134.46	5.52	3.12	0.23	1.42	2.48	YES	Concrete Drop Structure
12210	16912	700	1126.50	1128.30	1134.50	1.80	21.57	2.83	2.26	6.20	YES	
12216	16918	700	1126.50	1128.84	1134.50	2.34	21.05	2.73	2.31	5.66	YES	
12240	16942	700	1130.50	1134.61	1138.50	4.11	10.75	1.00	2.00	3.89	YES	
12270	16972	700	1130.53	1136.47	1138.53	5.94	2.73	0.25	1.51	2.06	YES	Riprap
12450	17152	700	1130.71	1136.52	1138.71	5.81	2.66	0.25	1.48	2.19	YES	
12665	17367	700	1130.92	1136.56	1138.92	5.64	2.96	0.28	1.44	2.36	YES	Riprap
12679	17381	700	1130.93	1136.53	1138.93	5.60	3.48	0.28	1.45	2.40	YES	
12680	17382	700	1130.93	1136.58	1138.93	5.65	3.05	0.23	1.45	2.35	YES	Concrete Drop Structure
12710	17412	700	1130.97	1132.70	1138.97	1.73	20.27	2.72	2.03	6.27	YES	
12716	17418	700	1130.97	1133.25	1138.97	2.28	19.67	2.60	2.07	5.72	YES	
12736	17438	700	1134.29	1138.15	1142.29	3.86	10.39	1.00	2.00	4.14	YES	
12767	17469	700	1134.34	1139.87	1141.34	5.53	2.81	0.26	1.41	1.47	YES	Riprap
12900	17602	700	1134.46	1139.94	1141.46	5.48	2.37	0.22	1.39	1.52	YES	
13100	17802	700	1134.76	1139.98	1141.76	5.22	2.61	0.25	1.33	1.78	YES	
13175	17877	700	1134.89	1139.87	1141.89	4.98	4.54	0.39	1.33	2.02	YES	
13185	17887	700	1135.99	1139.83	1142.99	3.84	4.98	0.45	1.06	3.16	YES	
Culvert (Osborn Rd)												
13235	17937	700	1135.87	1140.12	1142.87	4.25	4.43	0.38	1.14	2.75	YES	
13248	17950	700	1136.01	1137.10	1143.01	1.09	18.56	3.27	2.00	5.91	YES	
13266	17968	700	1139.67	1142.00	1146.67	2.33	8.44	1.01	2.00	4.67	YES	
13296	17998	700	1139.96	1142.97	1146.96	3.01	4.25	0.50	1.00	3.99	YES	
13600	18302	700	1140.28	1143.32	1147.28	3.04	3.74	0.42	1.00	3.96	YES	
13900	18602	700	1140.60	1143.55	1147.60	2.95	4.26	0.50	1.00	4.05	YES	
14100	18802	700	1140.80	1143.75	1147.80	2.95	4.90	0.61	1.00	4.05	YES	
14150	18852	700	1140.86	1143.31	1147.86	2.45	8.74	1.09	2.00	4.55	YES	
14175	18877	700	1141.28	1143.05	1148.28	1.77	10.86	1.50	2.00	5.23	YES	
Culvert (Clarendon Ave)												
14225	18927	700	1141.43	1142.55	1148.43	1.12	16.28	2.70	2.00	5.88	YES	
14238	18940	700	1141.44	1142.50	1148.44	1.06	18.25	3.20	2.00	5.94	YES	
14255	18957	700	1144.86	1147.19	1151.86	2.33	8.42	1.01	2.00	4.67	YES	
14300	19002	700	1145.30	1148.03	1152.30	2.73	5.27	0.66	1.00	4.27	YES	
14600	19302	700	1145.55	1148.63	1152.55	3.08	3.86	0.44	1.00	3.92	YES	

15000	19702	700	1145.98	1147.37	1152.98	1.39	12.84	2.38	2.00	5.61	YES	
15042	19744	700	1146.00	1148.67	1154.00	2.67	13.09	1.41	2.00	5.33	YES	
15046	19748	700	1146.41	1149.76	1154.41	3.35	10.43	1.01	2.00	4.65	YES	
15081	19783	700	1146.44	1151.48	1154.44	5.04	3.07	0.29	1.30	2.96	YES	
15300	20002	700	1146.66	1151.55	1154.66	4.89	3.21	0.31	1.26	3.11	YES	
15485	20187	700	1146.85	1151.62	1154.85	4.77	3.32	0.33	1.24	3.23	YES	Riprap
15500	20202	700	1146.85	1151.56	1154.85	4.71	4.27	0.38	1.25	3.29	YES	
15501	20203	700	1146.85	1151.65	1154.85	4.80	3.60	0.29	1.25	3.20	YES	Concrete Drop Structure
15531	20233	700	1146.89	1148.69	1154.89	1.80	21.56	2.83	2.25	6.20	YES	
15537	20239	700	1146.89	1149.24	1154.89	2.35	21.05	2.73	2.31	5.65	YES	
15561	20263	700	1150.89	1154.98	1158.89	4.09	10.80	1.01	2.00	3.91	YES	
15591	20293	700	1150.92	1156.90	1158.92	5.98	2.29	0.20	1.52	2.02	YES	Riprap
15731	20433	700	1151.06	1156.92	1159.06	5.86	2.31	0.21	1.49	2.14	YES	Riprap
15741	20443	700	1151.06	1156.90	1159.06	5.84	2.64	0.21	1.49	2.16	YES	Concrete Apron
15742	20444	700	1151.09	1156.93	1159.09	5.84	2.32	0.17	1.48	2.16	YES	
Culvert (Indian School Rd)												
15919	20620	700	1151.88	1154.45	1161.49	2.57	17.02	1.87	2.00	7.04	YES	Concrete Drop Inlet
15939	20640	700	1153.48	1157.37	1161.48	3.89	11.23	1.01	2.00	4.11	YES	
15984	20686	700	1153.52	1159.44	1161.52	5.92	2.33	0.21	1.50	2.08	YES	Riprap
16200	20902	800	1153.73	1159.48	1161.73	5.75	2.49	0.23	1.46	2.25	YES	
16500	21202	800	1154.03	1159.53	1162.03	5.50	2.94	0.27	1.41	2.50	YES	
16686	21388	800	1154.21	1159.57	1162.21	5.36	3.10	0.29	1.38	2.64	YES	Riprap
16700	21402	800	1154.22	1159.49	1162.22	5.27	4.27	0.35	1.39	2.73	YES	
16701	21403	800	1154.22	1159.57	1162.22	5.35	3.68	0.28	1.39	2.65	YES	Concrete Drop Structure
16731	21433	800	1154.26	1156.42	1162.26	2.16	18.53	2.23	2.00	5.84	YES	
16737	21439	800	1154.26	1157.02	1162.26	2.76	17.71	2.08	2.00	5.24	YES	
16749	21451	800	1156.26	1160.43	1164.26	4.17	10.86	1.00	2.00	3.83	YES	
16779	21481	800	1156.29	1162.36	1164.29	6.07	2.47	0.22	1.54	1.93	YES	Riprap
17050	21752	800	1156.56	1162.40	1164.56	5.84	2.68	0.24	1.49	2.16	YES	
17350	22052	800	1156.86	1162.46	1164.86	5.60	2.85	0.26	1.43	2.40	YES	
17486	22188	800	1156.99	1162.50	1164.99	5.51	2.98	0.28	1.41	2.49	YES	Riprap
17500	22202	800	1157.00	1162.42	1165.00	5.42	4.14	0.34	1.42	2.58	YES	
17501	22203	800	1157.00	1162.49	1165.00	5.49	3.59	0.27	1.42	2.51	YES	Concrete Drop Structure
17531	22233	800	1157.04	1159.20	1165.04	2.16	18.53	2.23	2.00	5.84	YES	
17537	22239	800	1157.04	1159.80	1165.04	2.76	17.70	2.08	2.00	5.24	YES	
17549	22251	800	1159.04	1163.20	1167.04	4.16	10.90	1.01	2.00	3.84	YES	
17579	22281	800	1159.07	1165.13	1167.07	6.06	2.55	0.23	1.54	1.94	YES	Riprap
17900	22602	800	1159.39	1165.19	1167.39	5.80	2.71	0.25	1.48	2.20	YES	
18200	22902	800	1159.69	1165.26	1167.69	5.57	2.88	0.27	1.42	2.43	YES	
18340	23033	800	1159.88	1164.16	1167.88	4.28	11.65	0.99	1.60	3.72	YES	
18920	23609	800	1161.06	1163.46	1169.06	2.40	20.77	2.36	2.27	5.60	YES	Broken-Back Culvert
18960	23640	800	1164.35	1168.13	1173.60	3.78	13.18	1.20	2.00	5.47	YES	
19252	23893	800	1165.42	1169.70	1173.42	4.28	11.65	0.99	1.60	3.72	YES	
19260	23900	800	1165.45	1171.60	1173.45	6.15	4.99	0.36	1.63	1.85	YES	
19267	23906	800	1165.45	1171.60	1173.45	6.15	4.99	0.36	1.63	1.85	YES	Concrete Drop Inlet
19277	23916	800	1166.45	1171.47	1174.45	5.02	6.12	0.48	1.40	2.98	YES	
19310	23940	800	1166.41	1171.97	1174.41	5.56	2.94	0.27	1.42	2.44	YES	Riprap

19650	24280	800	1166.73	1172.08	1174.73	5.35	2.77	0.26	1.37	2.65	YES	
19984	24614	800	1167.06	1172.16	1175.06	5.10	3.34	0.32	1.32	2.90	YES	Riprap
19999	24629	800	1167.07	1172.07	1175.07	5.00	4.54	0.39	1.33	3.00	YES	
20000	24630	800	1167.07	1172.17	1175.07	5.10	3.87	0.30	1.33	2.90	YES	Concrete Drop Structure
20030	24660	800	1167.11	1169.27	1175.11	2.16	18.53	2.23	2.00	5.84	YES	
20036	24666	800	1167.11	1169.87	1175.11	2.76	17.71	2.08	2.00	5.24	YES	
20048	24678	800	1169.11	1173.27	1177.11	4.16	10.90	1.01	2.00	3.84	YES	
20077	24707	800	1169.13	1175.21	1177.13	6.08	2.48	0.22	1.54	1.92	YES	Riprap
20300	24930	800	1169.36	1175.25	1177.36	5.89	2.42	0.22	1.50	2.11	YES	
20486	25116	800	1169.54	1175.28	1177.54	5.74	2.68	0.25	1.46	2.26	YES	Riprap
20501	25131	800	1169.55	1175.20	1177.55	5.65	3.94	0.31	1.47	2.35	YES	
20502	25132	800	1169.55	1175.26	1177.55	5.71	3.45	0.25	1.47	2.29	YES	Concrete Drop Structure
20532	25162	800	1169.59	1171.75	1177.59	2.16	18.53	2.23	2.00	5.84	YES	
20538	25168	800	1169.59	1172.35	1177.59	2.76	17.71	2.08	2.00	5.24	YES	
20550	25180	800	1171.59	1175.75	1179.59	4.16	10.91	1.01	2.00	3.84	YES	
20580	25210	800	1171.62	1177.68	1179.62	6.06	2.51	0.22	1.54	1.94	YES	Riprap
20850	25480	800	1171.89	1177.74	1179.89	5.85	2.47	0.22	1.49	2.15	YES	
21124	25754	800	1172.16	1177.79	1180.16	5.63	2.75	0.26	1.44	2.37	YES	Riprap
21135	25765	700	1172.19	1177.80	1180.19	5.61	2.77	0.22	1.43	2.39	YES	Concrete Apron
21136	25766	700	1172.50	1177.82	1180.50	5.32	2.55	0.19	1.36	2.68	YES	
Culvert (Camelback Rd)												
21275	25896	700	1173.05	1175.30	1183.91	2.25	19.39	2.28	2.02	8.61	YES	Concrete Drop Inlet
21308	25929	700	1175.91	1179.80	1183.91	3.89	11.22	1.00	2.00	4.11	YES	
21326	25956	700	1175.93	1181.83	1183.93	5.90	2.76	0.25	1.50	2.10	YES	Riprap
21600	26230	700	1176.13	1181.89	1184.13	5.76	2.86	0.27	1.47	2.24	YES	
21900	26530	700	1176.34	1181.98	1184.34	5.64	2.96	0.28	1.44	2.36	YES	
22200	26830	700	1176.55	1182.07	1184.55	5.52	3.07	0.29	1.42	2.48	YES	
22500	27130	700	1176.76	1182.17	1184.76	5.41	3.05	0.29	1.39	2.59	YES	
22615	27245	700	1176.84	1182.21	1184.84	5.37	3.09	0.30	1.38	2.63	YES	Riprap
22635	27265	700	1176.86	1182.05	1184.86	5.19	5.11	0.42	1.40	2.81	YES	
Culvert (Colter St)												
22711	27341	700	1177.68	1183.62	1188.90	5.94	4.39	0.34	1.56	5.28	YES	Riprap
22731	27361	700	1177.69	1183.85	1185.69	6.16	2.46	0.22	1.56	1.84	YES	
23000	27630	700	1177.88	1183.90	1185.88	6.02	2.67	0.24	1.53	1.98	YES	
23300	27930	700	1178.09	1183.97	1186.09	5.88	2.64	0.25	1.50	2.12	YES	
23619	28249	700	1178.31	1184.04	1186.31	5.73	2.89	0.27	1.46	2.27	YES	Riprap
23639	28269	700	1178.33	1183.91	1186.33	5.58	4.71	0.37	1.48	2.42	YES	
Culvert (Jackrabbit TR 2)												
24061	28590	700	1179.14	1185.00	1188.30	5.86	4.56	0.35	1.55	3.30	YES	Riprap
24081	28909	700	1179.16	1185.27	1187.16	6.11	2.44	0.22	1.55	1.89	YES	
24400	29209	500	1179.48	1185.37	1187.48	5.89	1.73	0.16	1.48	2.11	YES	
24700	29509	500	1179.78	1185.39	1187.78	5.61	1.97	0.19	1.42	2.39	YES	
25000	29704	500	1180.08	1185.44	1188.08	5.36	1.95	0.20	1.35	2.64	YES	
25195	29724	300	1180.28	1185.49	1188.28	5.21	1.42	0.14	1.31	2.79	YES	
25299	29808	300	1180.43	1185.50	1188.43	5.07	1.46	0.14	1.28	2.93	YES	
25600	30109	300	1180.73	1185.52	1188.73	4.79	1.65	0.17	1.21	3.21	YES	
25900	30409	300	1181.03	1185.56	1189.03	4.53	1.80	0.19	1.15	3.47	YES	
26200	30709	300	1181.33	1185.60	1189.33	4.27	1.96	0.21	1.08	3.73	YES	
26475	30984	300	1181.61	1185.65	1189.61	4.04	2.17	0.24	1.03	3.96	YES	Riprap
26495	31004	300	1181.63	1185.61	1189.63	3.98	2.98	0.29	1.03	4.02	YES	
Culvert (CIPP+HDPE)												
30801	35311	285	1187.13	1192.74	1195.13	5.61	2.94	0.22	1.44	2.39	YES	Riprap
30812	35321	285	1187.14	1192.85	1195.14	5.71	1.47	0.11	1.44	2.29	YES	
31000	35510	285	1187.33	1192.89	1194.33	5.56	0.24	0.02	1.39	1.44	YES	
31204	35713	285	1187.54	1192.87	1194.54	5.33	1.32	0.11	1.34	1.67	YES	
31216	35726	285	1187.55	1192.84	1194.55	5.29	2.27	0.17	1.34	1.71	YES	
31266	35776	285	1187.60	1192.77	1194.60	5.17	3.66	0.28	1.34	1.83	YES	

```
                    HEC-RAS Version 4.1.0 Jan 2010
                     U.S. Army Corps of Engineers
                    Hydrologic Engineering Center
                          609 Second Street
                          Davis, California

          X     X  XXXXXX    XXXX        XXXX       XX      XXXX
          X     X  X        X    X      X   X     X  X    X
          X     X  X        X           X   X    X    X   X
          XXXXXXX  XXXX     X       XXX XXXX     XXXXXX    XXXX
          X     X  X        X           X  X     X    X        X
          X     X  X        X    X      X   X    X    X        X
          X     X  XXXXXX    XXXX       X    X   X    X   XXXXX

*****************************************************************************

PROJECT DATA
Project Title: FRS3 Outlet Channel
Project File : WTO3MIXED.prj
Run Date and Time: 2/4/2011 1:16:09 PM

Project in English units

Project Description:
Project: White Tanks FRS #3 Outlet Channel Final Design

Prepared by:
Hoskin
Ryan Consultants

Prepared for:
Flood Control District of Maricopa
County

Storm Event: 100-Year
Manning's n for earthen channel were set at
0.02, assuming no vegetation at the initial stage after the
construction.
Discharges were obtained from the HEC-1 model prepared for this
project.

River station is along the alignment of channel.  Jackrabbit Trail
station is also provided for cross-sections in the description.

River
station is along the channel alignment.  Jackrabbit Trail station is also
provided for cross-sections in the description.


*****************************************************************************

PLAN DATA

Plan Title: Mixed Flow Calc
Plan File : G:\Projects\09\09-077 WTO3 Final\08 - 100% Design B\Hydro\HEC-RAS\WTO3MIXED.p01

          Geometry Title: Final Design
          Geometry File : G:\Projects\09\09-077 WTO3 Final\08 - 100% Design B\Hydro\HEC-RAS\WTO3MIXED.g01

          Flow Title    : 100-year design flow
          Flow File     : G:\Projects\09\09-077 WTO3 Final\08 - 100% Design B\Hydro\HEC-RAS\WTO3MIXED.f01

Plan Description:
Mixed flow with Manning's n=0.02


Plan Summary Information:
Number of:  Cross Sections =  617    Multiple Openings  =    0
            Culverts       =   14    Inline Structures  =    0
            Bridges        =    0    Lateral Structures =    0

Computational Information
    Water surface calculation tolerance  =  0.01
    Critical depth calculation tolerance =  0.01
    Maximum number of iterations         =  20
    Maximum difference tolerance         =  0.3
    Flow tolerance factor                =  0.001

Computation Options
    Critical depth computed only where necessary
    Conveyance Calculation Method: At breaks in n values only
    Friction Slope Method:         Average Conveyance
    Computational Flow Regime:     Mixed Flow


*****************************************************************************

FLOW DATA

Flow Title: 100-year design flow
Flow File : G:\Projects\09\09-077 WTO3 Final\08 - 100% Design B\Hydro\HEC-RAS\WTO3MIXED.f01

Flow Data (cfs)
*************************************************************
* River          Reach          RS       *          Low N *
* Channel        FRS3           31266.2  *            285 *
* Channel        FRS3           26495    *            300 *
* Channel        FRS3           25000    *            500 *
* Channel        FRS3           24081    *            700 *
* Channel        FRS3           21124    *            800 *
* Channel        FRS3           15984    *            700 *
* Channel        FRS3           5400     *           1328 *
* Channel        FRS3           4748     *           1549 *
*************************************************************

Boundary Conditions
*****************************************************************************************************************
* River          Reach          Profile          *          Upstream                    Downstream    *
*****************************************************************************************************************
* Channel        FRS3           Low N            *       Normal S = 0.001        Known WS = 1052.1 *
*****************************************************************************************************************
Inline Structure Gate Openings
River = Channel
Reach = FRS3              RS = 30790
Gate  = Slide Gate
  # Open Open Ht
****************
       5       2

*****************************************************************************

SUMMARY OF MANNING'S N VALUES

River:Channel
*******************************************************************
*     Reach      *   River Sta.   *   n1    *   n2    *   n3    *
*******************************************************************
*FRS3            *   31266.2      *   .045* .015*     .045*
*FRS3            *   31216.2      *   .045* .035*     .045*
*FRS3            *   31211.9*     *   .045*  .03*     .045*
*FRS3            *   31207.7*     *   .045* .025*     .045*
*FRS3            *   31203.5      *   .045*  .02*     .045*
*FRS3            *   31185.*      *   .045*  .02*     .045*
*FRS3            *   31166.5*     *   .045*  .02*     .045*
*FRS3            *   31148.*      *   .045*  .02*     .045*
*FRS3            *   31129.5*     *   .045*  .02*     .045*
*FRS3            *   31111.*      *   .045*  .02*     .045*
*FRS3            *   31092.5*     *   .045*  .02*     .045*
*FRS3            *   31074.*      *   .045*  .02*     .045*
*FRS3            *   31055.5*     *   .045*  .02*     .045*
*FRS3            *   31037.*      *   .045*  .02*     .045*
*FRS3            *   31018.5*     *   .045*  .02*     .045*
*FRS3            *   31000        *   .045*  .02*     .045*
*FRS3            *   30981.1*     *   .045*  .02*     .045*
*FRS3            *   30962.3*     *   .045*  .02*     .045*
*FRS3            *   30943.4*     *   .045*  .02*     .045*
*FRS3            *   30924.6*     *   .045*  .02*     .045*
*FRS3            *   30905.7*     *   .045*  .02*     .045*
*FRS3            *   30886.9*     *   .045*  .02*     .045*
*FRS3            *   30868.0*     *   .045*  .02*     .045*
*FRS3            *   30849.2*     *   .045*  .02*     .045*
*FRS3            *   30830.3*     *   .045*  .02*     .045*
*FRS3            *   30811.5      *   .045*  .02*     .045*
*FRS3            *   30801.1      *   .045* .035*     .045*
*FRS3            *   30801        *Culvert  *       *       *
*FRS3            *   26495        *   .045*  .02*     .045*
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*FRS3      *  26490.*   *    .045*    .02*    .045*
*FRS3      *  26485.*   *    .045*    .02*    .045*
*FRS3      *  26480.*   *    .045*    .02*    .045*
*FRS3      *  26475     *    .045*    .02*    .045*
*FRS3      *  26200     *    .045*    .02*    .045*
*FRS3      *  25900     *    .045*    .02*    .045*
*FRS3      *  25600     *    .045*    .02*    .045*
*FRS3      *  25299     *    .045*    .02*    .045*
*FRS3      *  25195     *    .045*    .02*    .045*
*FRS3      *  25000     *    .045*    .02*    .045*
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*FRS3      *  24081     *    .045*    .02*    .045*
*FRS3      *  24076.*   *    .045*   .024*    .045*
*FRS3      *  24071.*   *    .045*   .027*    .045*
*FRS3      *  24066.*   *    .045*   .031*    .045*
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*FRS3      *  24052.5   *Culvert  *      *       *
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*FRS3      *  23634.*   *    .045*   .031*    .045*
*FRS3      *  23629.*   *    .045*   .027*    .045*
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*FRS3      *  23619     *    .045*    .02*    .045*
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*FRS3      *  23000     *    .045*    .02*    .045*
*FRS3      *  22731     *    .045*    .02*    .045*
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*FRS3      *  22716.*   *    .045*   .031*    .045*
*FRS3      *  22711     *    .045*   .035*    .045*
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*FRS3      *  21274.9   *    .045*   .015*    .045*
*FRS3      *  21265.8   *Culvert  *      *       *
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*FRS3      *  21135     *    .045*   .035*    .045*
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*FRS3      *  21127.6*  *    .028*   .042*    .045*
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*FRS3      *  16737     *    .045*   .015*    .045*
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*FRS3      *  15979.4*  *    .045*    .02*    .045*
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*FRS3	*	8418.5*	*	.045*	.018*	.045*
*FRS3	*	8413.87*	*	.045*	.017*	.045*
*FRS3	*	8409.25*	*	.045*	.016*	.045*
*FRS3	*	8404.62*	*	.045*	.016*	.045*
*FRS3	*	8400	*	.045*	.015*	.045*
*FRS3	*	8376	*	.045*	.015*	.045*
*FRS3	*	8370	*	.045*	.015*	.045*
*FRS3	*	8365.*	*	.045*	.015*	.045*
*FRS3	*	8360.*	*	.045*	.015*	.045*
*FRS3	*	8355.*	*	.045*	.015*	.045*
*FRS3	*	8350.*	*	.045*	.015*	.045*
*FRS3	*	8345.*	*	.045*	.015*	.045*

*FRS3	*	8340	* .045*	.015*	.045*
*FRS3	*	8339	* .045*	.035*	.045*
*FRS3	*	8334.33*	* .045*	.03*	.045*
*FRS3	*	8329.66*	* .045*	.025*	.045*
*FRS3	*	8325	* .045*	.02*	.045*
*FRS3	*	8150	* .045*	.02*	.045*
*FRS3	*	8004	* .045*	.02*	.045*
*FRS3	*	7999.2*	* .045*	.019*	.045*
*FRS3	*	7994.4*	* .045*	.019*	.045*
*FRS3	*	7989.6*	* .045*	.018*	.045*
*FRS3	*	7984.8*	* .045*	.017*	.045*
*FRS3	*	7980.*	* .045*	.016*	.045*
*FRS3	*	7975.2*	* .045*	.016*	.045*
*FRS3	*	7970.4	* .045*	.015*	.045*
*FRS3	*	7960.4	* .045*	.015*	.045*
*FRS3	*	7958.2	*Culvert *	*	*
*FRS3	*	7907.3	* .045*	.015*	.045*
*FRS3	*	7903.04*	* .045*	.015*	.045*
*FRS3	*	7898.78*	* .045*	.015*	.045*
*FRS3	*	7894.52*	* .045*	.015*	.045*
*FRS3	*	7890.26*	* .045*	.015*	.045*
*FRS3	*	7886	* .045*	.015*	.045*
*FRS3	*	7885	* .045*	.035*	.045*
*FRS3	*	7882.*	* .045*	.03*	.045*
*FRS3	*	7879.*	* .045*	.025*	.045*
*FRS3	*	7876	* .045*	.02*	.045*
*FRS3	*	7700	* .045*	.02*	.045*
*FRS3	*	7425	* .045*	.02*	.045*
*FRS3	*	7420.1*	* .045*	.02*	.045*
*FRS3	*	7415.2*	* .045*	.019*	.045*
*FRS3	*	7410.3*	* .045*	.019*	.045*
*FRS3	*	7405.4*	* .045*	.018*	.045*
*FRS3	*	7400.5*	* .045*	.018*	.045*
*FRS3	*	7395.6*	* .045*	.017*	.045*
*FRS3	*	7390.7*	* .045*	.016*	.045*
*FRS3	*	7385.8*	* .045*	.016*	.045*
*FRS3	*	7380.9*	* .045*	.015*	.045*
*FRS3	*	7376	* .045*	.015*	.045*
*FRS3	*	7358	* .045*	.015*	.045*
*FRS3	*	7352	* .045*	.015*	.045*
*FRS3	*	7347.*	* .045*	.015*	.045*
*FRS3	*	7342.*	* .045*	.015*	.045*
*FRS3	*	7337.*	* .045*	.015*	.045*
*FRS3	*	7332.*	* .045*	.015*	.045*
*FRS3	*	7327.*	* .045*	.015*	.045*
*FRS3	*	7322	* .045*	.015*	.045*
*FRS3	*	7321	* .045*	.035*	.045*
*FRS3	*	7316.*	* .045*	.03*	.045*
*FRS3	*	7311.*	* .045*	.025*	.045*
*FRS3	*	7306	* .045*	.02*	.045*
*FRS3	*	7150	* .045*	.02*	.045*
*FRS3	*	7030	* .045*	.02*	.045*
*FRS3	*	7025.*	* .045*	.019*	.045*
*FRS3	*	7020.*	* .045*	.018*	.045*
*FRS3	*	7015.*	* .045*	.018*	.045*
*FRS3	*	7010.*	* .045*	.017*	.045*
*FRS3	*	7005.*	* .045*	.016*	.045*
*FRS3	*	7000	* .045*	.015*	.045*
*FRS3	*	6982	* .045*	.015*	.045*
*FRS3	*	6976	* .045*	.015*	.045*
*FRS3	*	6971.*	* .045*	.015*	.045*
*FRS3	*	6966.*	* .045*	.015*	.045*
*FRS3	*	6961.*	* .045*	.015*	.045*
*FRS3	*	6956.*	* .045*	.015*	.045*
*FRS3	*	6951.*	* .045*	.015*	.045*
*FRS3	*	6946	* .045*	.015*	.045*
*FRS3	*	6945	* .045*	.035*	.045*
*FRS3	*	6940.*	* .045*	.03*	.045*
*FRS3	*	6935.*	* .045*	.025*	.045*
*FRS3	*	6930	* .045*	.02*	.045*
*FRS3	*	6800	* .045*	.02*	.045*
*FRS3	*	6700	* .045*	.02*	.045*
*FRS3	*	6695.52*	* .045*	.019*	.045*
*FRS3	*	6691.05*	* .045*	.018*	.045*
*FRS3	*	6686.58*	* .045*	.018*	.045*
*FRS3	*	6682.10*	* .045*	.017*	.045*
*FRS3	*	6677.63*	* .045*	.016*	.045*
*FRS3	*	6673.16	* .045*	.015*	.045*
*FRS3	*	6663.16	* .045*	.015*	.045*
*FRS3	*	6661.6	*Culvert *	*	*
*FRS3	*	6570	* .035*	.015*	.035*
*FRS3	*	6565.*	* .035*	.015*	.035*
*FRS3	*	6560.*	* .035*	.015*	.035*
*FRS3	*	6555.*	* .035*	.015*	.035*
*FRS3	*	6550	* .035*	.015*	.035*
*FRS3	*	6200	* .035*	.015*	.035*
*FRS3	*	5920	* .035*	.015*	.035*
*FRS3	*	5902	* .035*	.015*	.035*
*FRS3	*	5600	* .035*	.015*	.035*
*FRS3	*	5400	* .035*	.015*	.035*
*FRS3	*	5342.1	*Culvert *	*	*
*FRS3	*	5220	* .035*	.015*	.035*
*FRS3	*	5193	* .035*	.015*	.035*
*FRS3	*	5181	* .035*	.015*	.035*
*FRS3	*	5100	* .035*	.015*	.035*
*FRS3	*	4800	* .035*	.015*	.035*
*FRS3	*	4748	* .035*	.015*	.035*
*FRS3	*	4740	* .035*	.015*	.035*
*FRS3	*	4729.5	*Culvert *	*	*
*FRS3	*	4650	* .035*	.015*	.035*
*FRS3	*	4600	* .035*	.015*	.035*
*FRS3	*	4350	* .035*	.015*	.035*
*FRS3	*	4278	* .035*	.015*	.035*
*FRS3	*	4271	*Culvert *	*	*
*FRS3	*	4200	* .035*	.015*	.035*
*FRS3	*	4183	* .035*	.015*	.035*
*FRS3	*	4168	* .035*	.015*	.035*
*FRS3	*	4100	* .035*	.015*	.035*
*FRS3	*	3800	* .035*	.015*	.035*
*FRS3	*	3500	* .035*	.015*	.035*
*FRS3	*	3200	* .035*	.015*	.035*
*FRS3	*	2903	* .035*	.015*	.035*
*FRS3	*	2885	* .035*	.015*	.035*
*FRS3	*	2800	* .035*	.015*	.035*
*FRS3	*	2500	* .035*	.015*	.035*
*FRS3	*	2200	* .035*	.015*	.035*
*FRS3	*	1900	* .035*	.015*	.035*
*FRS3	*	1568	* .035*	.015*	.035*
*FRS3	*	1552	* .035*	.015*	.035*
*FRS3	*	1500	* .035*	.015*	.035*
*FRS3	*	1300	* .035*	.015*	.035*
*FRS3	*	1000	* .035*	.015*	.035*

SUMMARY OF REACH LENGTHS

River: Channel

Reach	River Sta.	Left	Channel	Right
*FRS3	31266.2	50	50	50
*FRS3	31216.2	4.23	4.23	4.23
*FRS3	31211.9*	4.23	4.23	4.23
*FRS3	31207.7*	4.23	4.23	4.23
*FRS3	31203.5	18.5	18.5	18.5
*FRS3	31185.*	18.5	18.5	18.5
*FRS3	31166.5*	18.5	18.5	18.5
*FRS3	31148.*	18.5	18.5	18.5
*FRS3	31129.5*	18.5	18.5	18.5
*FRS3	31111.*	18.5	18.5	18.5
*FRS3	31092.5*	18.5	18.5	18.5
*FRS3	31074.*	18.5	18.5	18.5
*FRS3	31055.5*	18.5	18.5	18.5
*FRS3	31037.*	18.5	18.5	18.5
*FRS3	31018.5*	18.5	18.5	18.5
*FRS3	31000	18.85	18.85	18.85
*FRS3	30981.1*	18.85	18.85	18.85
*FRS3	30962.3*	18.85	18.85	18.85
*FRS3	30943.4*	18.85	18.85	18.85
*FRS3	30924.6*	18.85	18.85	18.85
*FRS3	30905.7*	18.85	18.85	18.85
*FRS3	30886.9*	18.85	18.85	18.85
*FRS3	30868.0*	18.85	18.85	18.85
*FRS3	30849.2*	18.85	18.85	18.85
*FRS3	30830.3*	18.85	18.85	18.85
*FRS3	30811.5	10.4	10.4	10.4
*FRS3	30801.1	4306.1	4306.1	4306.1
*FRS3	30801	*Culvert *	*	*

*FRS3	*	26495	*	5*	5*	5*
*FRS3	*	26490.*	*	5*	5*	5*
*FRS3	*	26485.*	*	5*	5*	5*
*FRS3	*	26480.*	*	5*	5*	5*
*FRS3	*	26475	*	275*	275*	275*
*FRS3	*	26200	*	300*	300*	300*
*FRS3	*	25900	*	300*	300*	300*
*FRS3	*	25600	*	301*	301*	301*
*FRS3	*	25299	*	104*	104*	104*
*FRS3	*	25195	*	195*	195*	195*
*FRS3	*	25000	*	300*	300*	300*
*FRS3	*	24700	*	300*	300*	300*
*FRS3	*	24400	*	319*	319*	319*
*FRS3	*	24081	*	5*	5*	5*
*FRS3	*	24076.*	*	5*	5*	5*
*FRS3	*	24071.*	*	5*	5*	5*
*FRS3	*	24066.*	*	5*	5*	5*
*FRS3	*	24061	*	422*	422*	422*
*FRS3	*	24052.5	*Culvert	*	*	*
*FRS3	*	23639	*	5*	5*	5*
*FRS3	*	23634.*	*	5*	5*	5*
*FRS3	*	23629.*	*	5*	5*	5*
*FRS3	*	23624.*	*	5*	5*	5*
*FRS3	*	23619	*	319*	319*	319*
*FRS3	*	23300	*	300*	300*	300*
*FRS3	*	23000	*	269*	269*	269*
*FRS3	*	22731	*	5*	5*	5*
*FRS3	*	22726.*	*	5*	5*	5*
*FRS3	*	22721.*	*	5*	5*	5*
*FRS3	*	22716.*	*	5*	5*	5*
*FRS3	*	22711	*	76*	76*	76*
*FRS3	*	22704.4	*Culvert	*	*	*
*FRS3	*	22635	*	5*	5*	5*
*FRS3	*	22630.*	*	5*	5*	5*
*FRS3	*	22625.*	*	5*	5*	5*
*FRS3	*	22620.*	*	5*	5*	5*
*FRS3	*	22615	*	115*	115*	115*
*FRS3	*	22500	*	300*	300*	300*
*FRS3	*	22200	*	300*	300*	300*
*FRS3	*	21900	*	300*	300*	300*
*FRS3	*	21600	*	274*	274*	274*
*FRS3	*	21326	*	4.55*	4.55*	4.55*
*FRS3	*	21321.4*	*	4.55*	4.55*	4.55*
*FRS3	*	21316.9*	*	4.55*	4.55*	4.55*
*FRS3	*	21312.3*	*	4.55*	4.55*	4.55*
*FRS3	*	21307.8	*	32.9*	32.9*	32.9*
*FRS3	*	21274.9	*	138.9*	138.9*	138.9*
*FRS3	*	21265.8	*Culvert	*	*	*
*FRS3	*	21136	*	1*	1*	1*
*FRS3	*	21135	*	6.67*	3.67*	6.67*
*FRS3	*	21131.3*	*	6.67*	3.67*	6.67*
*FRS3	*	21127.6*	*	6.67*	3.67*	6.67*
*FRS3	*	21124	*	274*	274*	274*
*FRS3	*	20850	*	270*	270*	270*
*FRS3	*	20580	*	5*	5*	5*
*FRS3	*	20575.*	*	5*	5*	5*
*FRS3	*	20570.*	*	5*	5*	5*
*FRS3	*	20565.*	*	5*	5*	5*
*FRS3	*	20560.*	*	5*	5*	5*
*FRS3	*	20555.*	*	5*	5*	5*
*FRS3	*	20550	*	12*	12*	12*
*FRS3	*	20538	*	6*	6*	6*
*FRS3	*	20532	*	5*	5*	5*
*FRS3	*	20527.*	*	5*	5*	5*
*FRS3	*	20522.*	*	5*	5*	5*
*FRS3	*	20517.*	*	5*	5*	5*
*FRS3	*	20512.*	*	5*	5*	5*
*FRS3	*	20507.*	*	5*	5*	5*
*FRS3	*	20502	*	1*	1*	1*
*FRS3	*	20501	*	6.67*	5*	6.67*
*FRS3	*	20496.*	*	6.67*	5*	6.67*
*FRS3	*	20491.*	*	6.67*	5*	6.67*
*FRS3	*	20486	*	186*	186*	186*
*FRS3	*	20300	*	223*	223*	223*
*FRS3	*	20077	*	4.83*	4.83*	4.83*
*FRS3	*	20072.1*	*	4.83*	4.83*	4.83*
*FRS3	*	20067.3*	*	4.83*	4.83*	4.83*
*FRS3	*	20062.5*	*	4.83*	4.83*	4.83*
*FRS3	*	20057.6*	*	4.83*	4.83*	4.83*
*FRS3	*	20052.8*	*	4.83*	4.83*	4.83*
*FRS3	*	20048	*	12*	12*	12*
*FRS3	*	20036	*	6*	6*	6*
*FRS3	*	20030	*	5*	5*	5*
*FRS3	*	20025.*	*	5*	5*	5*
*FRS3	*	20020.*	*	5*	5*	5*
*FRS3	*	20015.*	*	5*	5*	5*
*FRS3	*	20010.*	*	5*	5*	5*
*FRS3	*	20005.*	*	5*	5*	5*
*FRS3	*	20000	*	1*	1*	1*
*FRS3	*	19999	*	6.67*	5*	6.67*
*FRS3	*	19994.*	*	6.67*	5*	6.67*
*FRS3	*	19989.*	*	6.67*	5*	6.67*
*FRS3	*	19984	*	334*	334*	334*
*FRS3	*	19650	*	340*	340*	340*
*FRS3	*	19310	*	4.71*	4.71*	4.71*
*FRS3	*	19305.2*	*	4.71*	4.71*	4.71*
*FRS3	*	19300.5*	*	4.71*	4.71*	4.71*
*FRS3	*	19295.8*	*	4.71*	4.71*	4.71*
*FRS3	*	19291.1*	*	4.71*	4.71*	4.71*
*FRS3	*	19286.4*	*	4.71*	4.71*	4.71*
*FRS3	*	19281.7*	*	4.71*	4.71*	4.71*
*FRS3	*	19277	*	10*	10*	10*
*FRS3	*	19267	*	7*	7*	7*
*FRS3	*	19260	*	8.3*	8.3*	8.3*
*FRS3	*	19251.7	*	291.7*	291.7*	291.7*
*FRS3	*	18960	*	40*	40*	40*
*FRS3	*	18920	*	580*	580*	580*
*FRS3	*	18340	*	20*	20*	20*
*FRS3	*	18320.*	*	20*	20*	20*
*FRS3	*	18300.*	*	20*	20*	20*
*FRS3	*	18280.*	*	20*	20*	20*
*FRS3	*	18260.*	*	20*	20*	20*
*FRS3	*	18240.*	*	20*	20*	20*
*FRS3	*	18220.*	*	20*	20*	20*
*FRS3	*	18200	*	300*	300*	300*
*FRS3	*	17900	*	321*	321*	321*
*FRS3	*	17579	*	5*	5*	5*
*FRS3	*	17574.*	*	5*	5*	5*
*FRS3	*	17569.*	*	5*	5*	5*
*FRS3	*	17564.*	*	5*	5*	5*
*FRS3	*	17559.*	*	5*	5*	5*
*FRS3	*	17554.*	*	5*	5*	5*
*FRS3	*	17549	*	12*	12*	12*
*FRS3	*	17537	*	6*	6*	6*
*FRS3	*	17531	*	5*	5*	5*
*FRS3	*	17526.*	*	5*	5*	5*
*FRS3	*	17521.*	*	5*	5*	5*
*FRS3	*	17516.*	*	5*	5*	5*
*FRS3	*	17511.*	*	5*	5*	5*
*FRS3	*	17506.*	*	5*	5*	5*
*FRS3	*	17501	*	1*	1*	1*
*FRS3	*	17500	*	6.67*	4.67*	6.67*
*FRS3	*	17495.3*	*	6.67*	4.67*	6.67*
*FRS3	*	17490.6*	*	6.67*	4.67*	6.67*
*FRS3	*	17486	*	136*	136*	136*
*FRS3	*	17350	*	300*	300*	300*
*FRS3	*	17050	*	271.15*	271.15*	271.15*
*FRS3	*	16779	*	5*	5*	5*
*FRS3	*	16774.*	*	5*	5*	5*
*FRS3	*	16769.*	*	5*	5*	5*
*FRS3	*	16764.*	*	5*	5*	5*
*FRS3	*	16759.*	*	5*	5*	5*
*FRS3	*	16754.*	*	5*	5*	5*
*FRS3	*	16749	*	12*	12*	12*
*FRS3	*	16737	*	6*	6*	6*
*FRS3	*	16731	*	.95*	5*	5*
*FRS3	*	16726.*	*	.95*	5*	5*
*FRS3	*	16721.*	*	.95*	5*	5*
*FRS3	*	16716.*	*	.95*	5*	5*
*FRS3	*	16711.*	*	.95*	5*	5*
*FRS3	*	16706.*	*	.95*	5*	5*
*FRS3	*	16701	*	1*	1*	1*
*FRS3	*	16700	*	6.67*	4.67*	6.67*
*FRS3	*	16695.3*	*	6.67*	4.67*	6.67*
*FRS3	*	16690.6*	*	6.67*	4.67*	6.67*
*FRS3	*	16686	*	186*	186*	186*
*FRS3	*	16500	*	300*	300*	300*
*FRS3	*	16200	*	216*	216*	216*
*FRS3	*	15984	*	4.53*	4.53*	4.53*
*FRS3	*	15979.4*	*	4.53*	4.53*	4.53*

*FRS3	*	15974.9*	*	4.53*	4.53*	4.53*
*FRS3	*	15970.4*	*	4.53*	4.53*	4.53*
*FRS3	*	15965.8*	*	4.53*	4.53*	4.53*
*FRS3	*	15961.3*	*	4.53*	4.53*	4.53*
*FRS3	*	15956.8*	*	4.53*	4.53*	4.53*
*FRS3	*	15952.2*	*	4.53*	4.53*	4.53*
*FRS3	*	15947.7*	*	4.53*	4.53*	4.53*
*FRS3	*	15943.2*	*	4.53*	4.53*	4.53*
*FRS3	*	15938.7	*	20*	20*	20*
*FRS3	*	15918.7	*	176.3*	176.3*	176.3*
*FRS3	*	15918.6	*Culvert	*	*	*
*FRS3	*	15742.4	*	1*	1*	1*
*FRS3	*	15741.4	*	6.67*	3.47*	6.67*
*FRS3	*	15737.9*	*	6.67*	3.47*	6.67*
*FRS3	*	15734.4*	*	6.67*	3.47*	6.67*
*FRS3	*	15731	*	140*	140*	140*
*FRS3	*	15591	*	5*	5*	5*
*FRS3	*	15586.*	*	5*	5*	5*
*FRS3	*	15581.*	*	5*	5*	5*
*FRS3	*	15576.*	*	5*	5*	5*
*FRS3	*	15571.*	*	5*	5*	5*
*FRS3	*	15566.*	*	5*	5*	5*
*FRS3	*	15561	*	24*	24*	24*
*FRS3	*	15537	*	6*	6*	6*
*FRS3	*	15531	*	5*	5*	5*
*FRS3	*	15526.*	*	5*	5*	5*
*FRS3	*	15521.*	*	5*	5*	5*
*FRS3	*	15516.*	*	5*	5*	5*
*FRS3	*	15511.*	*	5*	5*	5*
*FRS3	*	15506.*	*	5*	5*	5*
*FRS3	*	15501	*	1*	1*	1*
*FRS3	*	15500	*	6.67*	5*	6.67*
*FRS3	*	15495.*	*	6.67*	5*	6.67*
*FRS3	*	15490.*	*	6.67*	5*	6.67*
*FRS3	*	15485	*	185*	185*	185*
*FRS3	*	15300	*	219*	219*	219*
*FRS3	*	15081	*	5*	5*	5*
*FRS3	*	15076.*	*	5*	5*	5*
*FRS3	*	15071.*	*	5*	5*	5*
*FRS3	*	15066.*	*	5*	5*	5*
*FRS3	*	15061.*	*	5*	5*	5*
*FRS3	*	15056.*	*	5*	5*	5*
*FRS3	*	15051.*	*	5*	5*	5*
*FRS3	*	15046	*	4*	4*	4*
*FRS3	*	15042	*	4.67*	4.67*	4.67*
*FRS3	*	15037.3*	*	4.67*	4.67*	4.67*
*FRS3	*	15032.6*	*	4.67*	4.67*	4.67*
*FRS3	*	15028.*	*	4.67*	4.67*	4.67*
*FRS3	*	15023.3*	*	4.67*	4.67*	4.67*
*FRS3	*	15018.6*	*	4.67*	4.67*	4.67*
*FRS3	*	15014.*	*	4.67*	4.67*	4.67*
*FRS3	*	15009.3*	*	4.67*	4.67*	4.67*
*FRS3	*	15004.6*	*	4.67*	4.67*	4.67*
*FRS3	*	15000	*	400*	400*	400*
*FRS3	*	14600	*	300*	300*	300*
*FRS3	*	14300	*	5*	5*	5*
*FRS3	*	14295.*	*	5*	5*	5*
*FRS3	*	14290.*	*	5*	5*	5*
*FRS3	*	14285.*	*	5*	5*	5*
*FRS3	*	14280.*	*	5*	5*	5*
*FRS3	*	14275.*	*	5*	5*	5*
*FRS3	*	14270.*	*	5*	5*	5*
*FRS3	*	14265.*	*	5*	5*	5*
*FRS3	*	14260.*	*	5*	5*	5*
*FRS3	*	14255	*	17*	17*	17*
*FRS3	*	14238	*	13*	13*	13*
*FRS3	*	14225	*	50*	50*	50*
*FRS3	*	14223.6	*Culvert	*	*	*
*FRS3	*	14175	*	25*	25*	25*
*FRS3	*	14150	*	5*	5*	5*
*FRS3	*	14145.*	*	5*	5*	5*
*FRS3	*	14140.*	*	5*	5*	5*
*FRS3	*	14135.*	*	5*	5*	5*
*FRS3	*	14130.*	*	5*	5*	5*
*FRS3	*	14125.*	*	5*	5*	5*
*FRS3	*	14120.*	*	5*	5*	5*
*FRS3	*	14115.*	*	5*	5*	5*
*FRS3	*	14110.*	*	5*	5*	5*
*FRS3	*	14105.*	*	5*	5*	5*
*FRS3	*	14100	*	200*	200*	200*
*FRS3	*	13900	*	300*	300*	300*
*FRS3	*	13600	*	304*	304*	304*
*FRS3	*	13296	*	5*	5*	5*
*FRS3	*	13291.*	*	5*	5*	5*
*FRS3	*	13286.*	*	5*	5*	5*
*FRS3	*	13281.*	*	5*	5*	5*
*FRS3	*	13276.*	*	5*	5*	5*
*FRS3	*	13271.*	*	5*	5*	5*
*FRS3	*	13266	*	18*	18*	18*
*FRS3	*	13248	*	13*	13*	13*
*FRS3	*	13235	*	50*	50*	50*
*FRS3	*	13233.5	*Culvert	*	*	*
*FRS3	*	13185	*	10*	10*	10*
*FRS3	*	13175	*	5*	5*	5*
*FRS3	*	13170.*	*	5*	5*	5*
*FRS3	*	13165.*	*	5*	5*	5*
*FRS3	*	13160.*	*	5*	5*	5*
*FRS3	*	13155.*	*	5*	5*	5*
*FRS3	*	13150.*	*	5*	5*	5*
*FRS3	*	13145.*	*	5*	5*	5*
*FRS3	*	13140.*	*	5*	5*	5*
*FRS3	*	13135.*	*	5*	5*	5*
*FRS3	*	13130.*	*	5*	5*	5*
*FRS3	*	13125.*	*	5*	5*	5*
*FRS3	*	13120.*	*	5*	5*	5*
*FRS3	*	13115.*	*	5*	5*	5*
*FRS3	*	13110.*	*	5*	5*	5*
*FRS3	*	13105.*	*	5*	5*	5*
*FRS3	*	13100	*	200*	200*	200*
*FRS3	*	12900	*	133*	133*	133*
*FRS3	*	12767	*	4.43*	4.43*	4.43*
*FRS3	*	12762.5*	*	4.43*	4.43*	4.43*
*FRS3	*	12758.1*	*	4.43*	4.43*	4.43*
*FRS3	*	12753.7*	*	4.43*	4.43*	4.43*
*FRS3	*	12749.2*	*	4.43*	4.43*	4.43*
*FRS3	*	12744.8*	*	4.43*	4.43*	4.43*
*FRS3	*	12740.4*	*	4.43*	4.43*	4.43*
*FRS3	*	12736	*	20*	20*	20*
*FRS3	*	12716	*	6*	6*	6*
*FRS3	*	12710	*	5*	5*	5*
*FRS3	*	12705.*	*	5*	5*	5*
*FRS3	*	12700.*	*	5*	5*	5*
*FRS3	*	12695.*	*	5*	5*	5*
*FRS3	*	12690.*	*	5*	5*	5*
*FRS3	*	12685.*	*	5*	5*	5*
*FRS3	*	12680	*	1*	1*	1*
*FRS3	*	12679	*	6.67*	4.67*	6.67*
*FRS3	*	12674.3*	*	6.67*	4.67*	6.67*
*FRS3	*	12669.6*	*	6.67*	4.67*	6.67*
*FRS3	*	12665	*	215*	215*	215*
*FRS3	*	12450	*	180*	180*	180*
*FRS3	*	12270	*	5*	5*	5*
*FRS3	*	12265.*	*	5*	5*	5*
*FRS3	*	12260.*	*	5*	5*	5*
*FRS3	*	12255.*	*	5*	5*	5*
*FRS3	*	12250.*	*	5*	5*	5*
*FRS3	*	12245.*	*	5*	5*	5*
*FRS3	*	12240	*	24*	24*	24*
*FRS3	*	12216	*	6*	6*	6*
*FRS3	*	12210	*	5*	5*	5*
*FRS3	*	12205.*	*	5*	5*	5*
*FRS3	*	12200.*	*	5*	5*	5*
*FRS3	*	12195.*	*	5*	5*	5*
*FRS3	*	12190.*	*	5*	5*	5*
*FRS3	*	12185.*	*	5*	5*	5*
*FRS3	*	12180	*	1*	1*	1*
*FRS3	*	12179	*	6.67*	5*	6.67*
*FRS3	*	12174.*	*	6.67*	5*	6.67*
*FRS3	*	12169.*	*	6.67*	5*	6.67*
*FRS3	*	12164	*	264*	264*	264*
*FRS3	*	11900	*	310*	310*	310*
*FRS3	*	11590	*	5*	5*	5*
*FRS3	*	11585.*	*	5*	5*	5*
*FRS3	*	11580.*	*	5*	5*	5*
*FRS3	*	11575.*	*	5*	5*	5*
*FRS3	*	11570.*	*	5*	5*	5*
*FRS3	*	11565.*	*	5*	5*	5*
*FRS3	*	11560	*	24*	24*	24*
*FRS3	*	11536	*	6*	6*	6*
*FRS3	*	11530	*	5*	5*	5*

*FRS3	*	11525.*	*	5*	5*	5*
*FRS3	*	11520.*	*	5*	5*	5*
*FRS3	*	11515.*	*	5*	5*	5*
*FRS3	*	11510.*	*	5*	5*	5*
*FRS3	*	11505.*	*	5*	5*	5*
*FRS3	*	11500	*	1*	1*	1*
*FRS3	*	11499	*	6.67*	5*	6.67*
*FRS3	*	11494.*	*	6.67*	5*	6.67*
*FRS3	*	11489.*	*	6.67*	5*	6.67*
*FRS3	*	11484	*	184*	184*	184*
*FRS3	*	11300	*	167*	167*	167*
*FRS3	*	11133	*	4.75*	4.75*	4.75*
*FRS3	*	11128.2*	*	4.75*	4.75*	4.75*
*FRS3	*	11123.5*	*	4.75*	4.75*	4.75*
*FRS3	*	11118.7*	*	4.75*	4.75*	4.75*
*FRS3	*	11114.*	*	4.75*	4.75*	4.75*
*FRS3	*	11109.2*	*	4.75*	4.75*	4.75*
*FRS3	*	11104.5*	*	4.75*	4.75*	4.75*
*FRS3	*	11099.7*	*	4.75*	4.75*	4.75*
*FRS3	*	11095.*	*	4.75*	4.75*	4.75*
*FRS3	*	11090.2*	*	4.75*	4.75*	4.75*
*FRS3	*	11085.5	*	16.8*	16.8*	16.8*
*FRS3	*	11068.7	*	6*	6*	6*
*FRS3	*	11062.7	*	5*	5*	5*
*FRS3	*	11057.7*	*	5*	5*	5*
*FRS3	*	11052.7*	*	5*	5*	5*
*FRS3	*	11047.7*	*	5*	5*	5*
*FRS3	*	11042.7*	*	5*	5*	5*
*FRS3	*	11037.7*	*	5*	5*	5*
*FRS3	*	11032.7	*	1*	1*	1*
*FRS3	*	11031.7	*	6.67*	4.83*	6.67*
*FRS3	*	11026.8*	*	6.67*	4.83*	6.67*
*FRS3	*	11022.0*	*	6.67*	4.83*	6.67*
*FRS3	*	11017.2	*	217.2*	217.2*	217.2*
*FRS3	*	10800	*	155*	155*	155*
*FRS3	*	10645	*	4.59*	4.59*	4.59*
*FRS3	*	10640.4*	*	4.59*	4.59*	4.59*
*FRS3	*	10635.8*	*	4.59*	4.59*	4.59*
*FRS3	*	10631.2*	*	4.59*	4.59*	4.59*
*FRS3	*	10626.6*	*	4.59*	4.59*	4.59*
*FRS3	*	10622.0*	*	4.59*	4.59*	4.59*
*FRS3	*	10617.4*	*	4.59*	4.59*	4.59*
*FRS3	*	10612.8*	*	4.59*	4.59*	4.59*
*FRS3	*	10608.2*	*	4.59*	4.59*	4.59*
*FRS3	*	10603.6*	*	4.59*	4.59*	4.59*
*FRS3	*	10599.1	*	64*	64*	64*
*FRS3	*	10598	*Culvert	*	*	*
*FRS3	*	10535.1	*	4.86*	4.86*	4.86*
*FRS3	*	10530.2*	*	4.86*	4.86*	4.86*
*FRS3	*	10525.3*	*	4.86*	4.86*	4.86*
*FRS3	*	10520.5*	*	4.86*	4.86*	4.86*
*FRS3	*	10515.6*	*	4.86*	4.86*	4.86*
*FRS3	*	10510.8	*	1*	1*	1*
*FRS3	*	10509.8	*	10*	4.9*	10*
*FRS3	*	10504.9*	*	10*	4.9*	10*
*FRS3	*	10500	*	150*	150*	150*
*FRS3	*	10350	*	196*	196*	196*
*FRS3	*	10154	*	5*	5*	5*
*FRS3	*	10149.*	*	5*	5*	5*
*FRS3	*	10144.*	*	5*	5*	5*
*FRS3	*	10139.*	*	5*	5*	5*
*FRS3	*	10134.*	*	5*	5*	5*
*FRS3	*	10129.*	*	5*	5*	5*
*FRS3	*	10124	*	24*	24*	24*
*FRS3	*	10100	*	6*	6*	6*
*FRS3	*	10094	*	5*	5*	5*
*FRS3	*	10089.*	*	5*	5*	5*
*FRS3	*	10084.*	*	5*	5*	5*
*FRS3	*	10079.*	*	5*	5*	5*
*FRS3	*	10074.*	*	5*	5*	5*
*FRS3	*	10069.*	*	5*	5*	5*
*FRS3	*	10064	*	1*	1*	1*
*FRS3	*	10063	*	6.67*	5*	6.67*
*FRS3	*	10058.*	*	6.67*	5*	6.67*
*FRS3	*	10053.*	*	6.67*	5*	6.67*
*FRS3	*	10048	*	148*	148*	148*
*FRS3	*	9900	*	172*	172*	172*
*FRS3	*	9728	*	4.82*	4.82*	4.82*
*FRS3	*	9723.18*	*	4.82*	4.82*	4.82*
*FRS3	*	9718.36*	*	4.82*	4.82*	4.82*
*FRS3	*	9713.54*	*	4.82*	4.82*	4.82*
*FRS3	*	9708.72*	*	4.82*	4.82*	4.82*
*FRS3	*	9703.90*	*	4.82*	4.82*	4.82*
*FRS3	*	9699.09*	*	4.82*	4.82*	4.82*
*FRS3	*	9694.27*	*	4.82*	4.82*	4.82*
*FRS3	*	9689.45*	*	4.82*	4.82*	4.82*
*FRS3	*	9684.63*	*	4.82*	4.82*	4.82*
*FRS3	*	9679.81*	*	4.82*	4.82*	4.82*
*FRS3	*	9675	*	15*	15*	15*
*FRS3	*	9660	*	6*	6*	6*
*FRS3	*	9654	*	5*	5*	5*
*FRS3	*	9649.*	*	5*	5*	5*
*FRS3	*	9644.*	*	5*	5*	5*
*FRS3	*	9639.*	*	5*	5*	5*
*FRS3	*	9634.*	*	5*	5*	5*
*FRS3	*	9629.*	*	5*	5*	5*
*FRS3	*	9624	*	1*	1*	1*
*FRS3	*	9623	*	6.67*	5*	6.67*
*FRS3	*	9618.*	*	6.67*	5*	6.67*
*FRS3	*	9613.*	*	6.67*	5*	6.67*
*FRS3	*	9608	*	158*	158*	158*
*FRS3	*	9450	*	151*	151*	151*
*FRS3	*	9299	*	4.48*	4.48*	4.48*
*FRS3	*	9294.51*	*	4.48*	4.48*	4.48*
*FRS3	*	9290.03*	*	4.48*	4.48*	4.48*
*FRS3	*	9285.55*	*	4.48*	4.48*	4.48*
*FRS3	*	9281.06*	*	4.48*	4.48*	4.48*
*FRS3	*	9276.58*	*	4.48*	4.48*	4.48*
*FRS3	*	9272.1	*	54*	54*	54*
*FRS3	*	9272	*Culvert	*	*	*
*FRS3	*	9218.1	*	4.86*	4.86*	4.86*
*FRS3	*	9213.23*	*	4.86*	4.86*	4.86*
*FRS3	*	9208.38*	*	4.86*	4.86*	4.86*
*FRS3	*	9203.52*	*	4.86*	4.86*	4.86*
*FRS3	*	9198.66*	*	4.86*	4.86*	4.86*
*FRS3	*	9193.8	*	1*	1*	1*
*FRS3	*	9192.8	*	10*	4.9*	10*
*FRS3	*	9187.9*	*	10*	4.9*	10*
*FRS3	*	9183	*	183*	183*	183*
*FRS3	*	9000	*	137*	137*	137*
*FRS3	*	8863	*	4.91*	4.91*	4.91*
*FRS3	*	8858.09*	*	4.91*	4.91*	4.91*
*FRS3	*	8853.18*	*	4.91*	4.91*	4.91*
*FRS3	*	8848.27*	*	4.91*	4.91*	4.91*
*FRS3	*	8843.36*	*	4.91*	4.91*	4.91*
*FRS3	*	8838.45*	*	4.91*	4.91*	4.91*
*FRS3	*	8833.54*	*	4.91*	4.91*	4.91*
*FRS3	*	8828.63*	*	4.91*	4.91*	4.91*
*FRS3	*	8823.72*	*	4.91*	4.91*	4.91*
*FRS3	*	8818.81*	*	4.91*	4.91*	4.91*
*FRS3	*	8813.90*	*	4.91*	4.91*	4.91*
*FRS3	*	8809	*	24*	24*	24*
*FRS3	*	8785	*	6*	6*	6*
*FRS3	*	8779	*	5*	5*	5*
*FRS3	*	8774.*	*	5*	5*	5*
*FRS3	*	8769.*	*	5*	5*	5*
*FRS3	*	8764.*	*	5*	5*	5*
*FRS3	*	8759.*	*	5*	5*	5*
*FRS3	*	8754.*	*	5*	5*	5*
*FRS3	*	8749	*	1*	1*	1*
*FRS3	*	8748	*	6.67*	5*	6.67*
*FRS3	*	8743.*	*	6.67*	5*	6.67*
*FRS3	*	8738.*	*	6.67*	5*	6.67*
*FRS3	*	8733	*	133*	133*	133*
*FRS3	*	8600	*	163*	163*	163*
*FRS3	*	8437	*	4.62*	4.62*	4.62*
*FRS3	*	8432.37*	*	4.62*	4.62*	4.62*
*FRS3	*	8427.75*	*	4.62*	4.62*	4.62*
*FRS3	*	8423.12*	*	4.62*	4.62*	4.62*
*FRS3	*	8418.5*	*	4.62*	4.62*	4.62*
*FRS3	*	8413.87*	*	4.62*	4.62*	4.62*
*FRS3	*	8409.25*	*	4.62*	4.62*	4.62*
*FRS3	*	8404.62*	*	4.62*	4.62*	4.62*
*FRS3	*	8400	*	24*	24*	24*
*FRS3	*	8376	*	6*	6*	6*
*FRS3	*	8370	*	5*	5*	5*
*FRS3	*	8365.*	*	5*	5*	5*
*FRS3	*	8360.*	*	5*	5*	5*
*FRS3	*	8355.*	*	5*	5*	5*
*FRS3	*	8350.*	*	5*	5*	5*

*FRS3	*	8345.*	*	5*	5*	5*
*FRS3	*	8340	*	1*	1*	1*
*FRS3	*	8339	*	6.67*	4.67*	6.67*
*FRS3	*	8334.33*	*	6.67*	4.67*	6.67*
*FRS3	*	8329.66*	*	6.67*	4.67*	6.67*
*FRS3	*	8325	*	175*	175*	175*
*FRS3	*	8150	*	146*	146*	146*
*FRS3	*	8004	*	4.8*	4.8*	4.8*
*FRS3	*	7999.2*	*	4.8*	4.8*	4.8*
*FRS3	*	7994.4*	*	4.8*	4.8*	4.8*
*FRS3	*	7989.6*	*	4.8*	4.8*	4.8*
*FRS3	*	7984.8*	*	4.8*	4.8*	4.8*
*FRS3	*	7980.*	*	4.8*	4.8*	4.8*
*FRS3	*	7975.2*	*	4.8*	4.8*	4.8*
*FRS3	*	7970.4	*	10*	10*	10*
*FRS3	*	7960.4	*	53.1*	53.1*	53.1*
*FRS3	*	7958.2	*Culvert	*	*	*
*FRS3	*	7907.3	*	4.26*	4.26*	4.26*
*FRS3	*	7903.04*	*	4.26*	4.26*	4.26*
*FRS3	*	7898.78*	*	4.26*	4.26*	4.26*
*FRS3	*	7894.52*	*	4.26*	4.26*	4.26*
*FRS3	*	7890.26*	*	4.26*	4.26*	4.26*
*FRS3	*	7886	*	1*	1*	1*
*FRS3	*	7885	*	6.33*	3*	6.33*
*FRS3	*	7882.*	*	6.33*	3*	6.33*
*FRS3	*	7879.*	*	6.33*	3*	6.33*
*FRS3	*	7876	*	176*	176*	176*
*FRS3	*	7700	*	275*	275*	275*
*FRS3	*	7425	*	4.9*	4.9*	4.9*
*FRS3	*	7420.1*	*	4.9*	4.9*	4.9*
*FRS3	*	7415.2*	*	4.9*	4.9*	4.9*
*FRS3	*	7410.3*	*	4.9*	4.9*	4.9*
*FRS3	*	7405.4*	*	4.9*	4.9*	4.9*
*FRS3	*	7400.5*	*	4.9*	4.9*	4.9*
*FRS3	*	7395.6*	*	4.9*	4.9*	4.9*
*FRS3	*	7390.7*	*	4.9*	4.9*	4.9*
*FRS3	*	7385.8*	*	4.9*	4.9*	4.9*
*FRS3	*	7380.9*	*	4.9*	4.9*	4.9*
*FRS3	*	7376	*	18*	18*	18*
*FRS3	*	7358	*	6*	6*	6*
*FRS3	*	7352	*	5*	5*	5*
*FRS3	*	7347.*	*	5*	5*	5*
*FRS3	*	7342.*	*	5*	5*	5*
*FRS3	*	7337.*	*	5*	5*	5*
*FRS3	*	7332.*	*	5*	5*	5*
*FRS3	*	7327.*	*	5*	5*	5*
*FRS3	*	7322	*	1*	1*	1*
*FRS3	*	7321	*	6.67*	5*	6.67*
*FRS3	*	7316.*	*	6.67*	5*	6.67*
*FRS3	*	7311.*	*	6.67*	5*	6.67*
*FRS3	*	7306	*	156*	156*	156*
*FRS3	*	7150	*	120*	120*	120*
*FRS3	*	7030	*	5*	5*	5*
*FRS3	*	7025.*	*	5*	5*	5*
*FRS3	*	7020.*	*	5*	5*	5*
*FRS3	*	7015.*	*	5*	5*	5*
*FRS3	*	7010.*	*	5*	5*	5*
*FRS3	*	7005.*	*	5*	5*	5*
*FRS3	*	7000	*	18*	18*	18*
*FRS3	*	6982	*	6*	6*	6*
*FRS3	*	6976	*	5*	5*	5*
*FRS3	*	6971.*	*	5*	5*	5*
*FRS3	*	6966.*	*	5*	5*	5*
*FRS3	*	6961.*	*	5*	5*	5*
*FRS3	*	6956.*	*	5*	5*	5*
*FRS3	*	6951.*	*	5*	5*	5*
*FRS3	*	6946	*	1*	1*	1*
*FRS3	*	6945	*	6.67*	5*	6.67*
*FRS3	*	6940.*	*	6.67*	5*	6.67*
*FRS3	*	6935.*	*	6.67*	5*	6.67*
*FRS3	*	6930	*	130*	130*	130*
*FRS3	*	6800	*	100*	100*	100*
*FRS3	*	6700	*	4.47*	4.47*	4.47*
*FRS3	*	6695.52*	*	4.47*	4.47*	4.47*
*FRS3	*	6691.05*	*	4.47*	4.47*	4.47*
*FRS3	*	6686.58*	*	4.47*	4.47*	4.47*
*FRS3	*	6682.10*	*	4.47*	4.47*	4.47*
*FRS3	*	6677.63*	*	4.47*	4.47*	4.47*
*FRS3	*	6673.16	*	10*	10*	10*
*FRS3	*	6663.16	*	93.16*	93.16*	93.16*
*FRS3	*	6661.6	*Culvert	*	*	*
*FRS3	*	6570	*	5*	5*	5*
*FRS3	*	6565.*	*	5*	5*	5*
*FRS3	*	6560.*	*	5*	5*	5*
*FRS3	*	6555.*	*	5*	5*	5*
*FRS3	*	6550	*	350*	350*	350*
*FRS3	*	6200	*	280*	280*	280*
*FRS3	*	5920	*	18*	18*	18*
*FRS3	*	5902	*	302*	302*	302*
*FRS3	*	5600	*	200*	200*	200*
*FRS3	*	5400	*	180*	180*	180*
*FRS3	*	5342.1	*Culvert	*	*	*
*FRS3	*	5220	*	27*	27*	27*
*FRS3	*	5193	*	12*	12*	12*
*FRS3	*	5181	*	81*	81*	81*
*FRS3	*	5100	*	300*	300*	300*
*FRS3	*	4800	*	52*	52*	52*
*FRS3	*	4748	*	8*	8*	8*
*FRS3	*	4740	*	90*	90*	90*
*FRS3	*	4729.5	*Culvert	*	*	*
*FRS3	*	4650	*	50*	50*	50*
*FRS3	*	4600	*	250*	250*	250*
*FRS3	*	4350	*	72*	72*	72*
*FRS3	*	4278	*	78*	78*	78*
*FRS3	*	4271	*Culvert	*	*	*
*FRS3	*	4200	*	17*	17*	17*
*FRS3	*	4183	*	15*	15*	15*
*FRS3	*	4168	*	68*	68*	68*
*FRS3	*	4100	*	300*	300*	300*
*FRS3	*	3800	*	300*	300*	300*
*FRS3	*	3500	*	300*	300*	300*
*FRS3	*	3200	*	297*	297*	297*
*FRS3	*	2903	*	18*	18*	18*
*FRS3	*	2885	*	85*	85*	85*
*FRS3	*	2800	*	300*	300*	300*
*FRS3	*	2500	*	300*	300*	300*
*FRS3	*	2200	*	300*	300*	300*
*FRS3	*	1900	*	332*	332*	332*
*FRS3	*	1568	*	16*	16*	16*
*FRS3	*	1552	*	52*	52*	52*
*FRS3	*	1500	*	200*	200*	200*
*FRS3	*	1300	*	300*	300*	300*
*FRS3	*	1000	*	0*	0*	0*

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SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: Channel

* Reach	*	River Sta.	* Contr.	* Expan. *
*FRS3	*	31266.2 *	.1*	.3*
*FRS3	*	31216.2 *	.1*	.3*
*FRS3	*	31211.9**	.1*	.3*
*FRS3	*	31207.7**	.1*	.3*
*FRS3	*	31203.5 *	.1*	.3*
*FRS3	*	31185.* *	.1*	.3*
*FRS3	*	31166.5**	.1*	.3*
*FRS3	*	31148.* *	.1*	.3*
*FRS3	*	31129.5**	.1*	.3*
*FRS3	*	31111.* *	.1*	.3*
*FRS3	*	31092.5**	.1*	.3*
*FRS3	*	31074.* *	.1*	.3*
*FRS3	*	31055.5**	.1*	.3*
*FRS3	*	31037.* *	.1*	.3*
*FRS3	*	31018.5**	.1*	.3*
*FRS3	*	31000 *	.1*	.3*
*FRS3	*	30981.1**	.1*	.3*
*FRS3	*	30962.3**	.1*	.3*
*FRS3	*	30943.4**	.1*	.3*
*FRS3	*	30924.6**	.1*	.3*
*FRS3	*	30905.7**	.1*	.3*
*FRS3	*	30886.9**	.1*	.3*
*FRS3	*	30868.0**	.1*	.3*
*FRS3	*	30849.2**	.1*	.3*
*FRS3	*	30830.3**	.1*	.3*
*FRS3	*	30811.5 *	.1*	.3*
*FRS3	*	30801.1 *	.1*	.3*

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*FRS3          *   30801   *Culvert  *         *
*FRS3          *   26495   *       .1*       .3*
*FRS3          *   26490.* *       .1*       .3*
*FRS3          *   26485.* *       .1*       .3*
*FRS3          *   26480.* *       .1*       .3*
*FRS3          *   26475   *       .1*       .3*
*FRS3          *   26200   *       .1*       .3*
*FRS3          *   25900   *       .1*       .3*
*FRS3          *   25600   *       .1*       .3*
*FRS3          *   25299   *       .1*       .3*
*FRS3          *   25195   *       .1*       .3*
*FRS3          *   25000   *       .1*       .3*
*FRS3          *   24700   *       .1*       .3*
*FRS3          *   24400   *       .1*       .3*
*FRS3          *   24081   *       .1*       .3*
*FRS3          *   24076.* *       .1*       .3*
*FRS3          *   24071.* *       .1*       .3*
*FRS3          *   24066.* *       .1*       .3*
*FRS3          *   24061   *       .1*       .3*
*FRS3          *   24052.5 *Culvert  *         *
*FRS3          *   23639   *       .1*       .3*
*FRS3          *   23634.* *       .1*       .3*
*FRS3          *   23629.* *       .1*       .3*
*FRS3          *   23624.* *       .1*       .3*
*FRS3          *   23619   *       .1*       .3*
*FRS3          *   23300   *       .1*       .3*
*FRS3          *   23000   *       .1*       .3*
*FRS3          *   22731   *       .1*       .3*
*FRS3          *   22726.* *       .1*       .3*
*FRS3          *   22721.* *       .1*       .3*
*FRS3          *   22716.* *       .1*       .3*
*FRS3          *   22711   *       .1*       .3*
*FRS3          *   22704.4 *Culvert  *         *
*FRS3          *   22635   *       .1*       .3*
*FRS3          *   22630.* *       .1*       .3*
*FRS3          *   22625.* *       .1*       .3*
*FRS3          *   22620.* *       .1*       .3*
*FRS3          *   22615   *       .1*       .3*
*FRS3          *   22500   *       .1*       .3*
*FRS3          *   22200   *       .1*       .3*
*FRS3          *   21900   *       .1*       .3*
*FRS3          *   21600   *       .1*       .3*
*FRS3          *   21326   *       .1*       .3*
*FRS3          *   21321.4**       .1*       .3*
*FRS3          *   21316.9**       .1*       .3*
*FRS3          *   21312.3**       .1*       .3*
*FRS3          *   21307.8 *       .1*       .3*
*FRS3          *   21274.9 *       .1*       .3*
*FRS3          *   21265.8 *Culvert  *         *
*FRS3          *   21136   *       .1*       .3*
*FRS3          *   21135   *       .1*       .3*
*FRS3          *   21131.3**       .1*       .3*
*FRS3          *   21127.6**       .1*       .3*
*FRS3          *   21124   *       .1*       .3*
*FRS3          *   20850   *       .1*       .3*
*FRS3          *   20580   *       .1*       .3*
*FRS3          *   20575.* *       .1*       .3*
*FRS3          *   20570.* *       .1*       .3*
*FRS3          *   20565.* *       .1*       .3*
*FRS3          *   20560.* *       .1*       .3*
*FRS3          *   20555.* *       .1*       .3*
*FRS3          *   20550   *       .1*       .3*
*FRS3          *   20538   *       .1*       .3*
*FRS3          *   20532   *       .1*       .3*
*FRS3          *   20527.* *       .1*       .3*
*FRS3          *   20522.* *       .1*       .3*
*FRS3          *   20517.* *       .1*       .3*
*FRS3          *   20512.* *       .1*       .3*
*FRS3          *   20507.* *       .1*       .3*
*FRS3          *   20502   *       .1*       .3*
*FRS3          *   20501   *       .1*       .3*
*FRS3          *   20496.* *       .1*       .3*
*FRS3          *   20491.* *       .1*       .3*
*FRS3          *   20486   *       .1*       .3*
*FRS3          *   20300   *       .1*       .3*
*FRS3          *   20077   *       .1*       .3*
*FRS3          *   20072.1**       .1*       .3*
*FRS3          *   20067.3**       .1*       .3*
*FRS3          *   20062.5**       .1*       .3*
*FRS3          *   20057.6**       .1*       .3*
*FRS3          *   20052.8**       .1*       .3*
*FRS3          *   20048   *       .1*       .3*
*FRS3          *   20036   *       .1*       .3*
*FRS3          *   20030   *       .1*       .3*
*FRS3          *   20025.* *       .1*       .3*
*FRS3          *   20020.* *       .1*       .3*
*FRS3          *   20015.* *       .1*       .3*
*FRS3          *   20010.* *       .1*       .3*
*FRS3          *   20005.* *       .1*       .3*
*FRS3          *   20000   *       .1*       .3*
*FRS3          *   19999   *       .1*       .3*
*FRS3          *   19994.* *       .1*       .3*
*FRS3          *   19989.* *       .1*       .3*
*FRS3          *   19984   *       .1*       .3*
*FRS3          *   19650   *       .1*       .3*
*FRS3          *   19310   *       .1*       .3*
*FRS3          *   19305.2**       .1*       .3*
*FRS3          *   19300.5**       .1*       .3*
*FRS3          *   19295.8**       .1*       .3*
*FRS3          *   19291.1**       .1*       .3*
*FRS3          *   19286.4**       .1*       .3*
*FRS3          *   19281.7**       .1*       .3*
*FRS3          *   19277   *       .1*       .3*
*FRS3          *   19267   *       .1*       .3*
*FRS3          *   19260   *       .1*       .3*
*FRS3          *   19251.7 *       .1*       .3*
*FRS3          *   18960   *       .1*       .3*
*FRS3          *   18920   *       .1*       .3*
*FRS3          *   18340   *       .1*       .3*
*FRS3          *   18320.* *       .1*       .3*
*FRS3          *   18300.* *       .1*       .3*
*FRS3          *   18280.* *       .1*       .3*
*FRS3          *   18260.* *       .1*       .3*
*FRS3          *   18240.* *       .1*       .3*
*FRS3          *   18220.* *       .1*       .3*
*FRS3          *   18200   *       .1*       .3*
*FRS3          *   17900   *       .1*       .3*
*FRS3          *   17579   *       .1*       .3*
*FRS3          *   17574.* *       .1*       .3*
*FRS3          *   17569.* *       .1*       .3*
*FRS3          *   17564.* *       .1*       .3*
*FRS3          *   17559.* *       .1*       .3*
*FRS3          *   17554.* *       .1*       .3*
*FRS3          *   17549   *       .1*       .3*
*FRS3          *   17537   *       .1*       .3*
*FRS3          *   17531   *       .1*       .3*
*FRS3          *   17526.* *       .1*       .3*
*FRS3          *   17521.* *       .1*       .3*
*FRS3          *   17516.* *       .1*       .3*
*FRS3          *   17511.* *       .1*       .3*
*FRS3          *   17506.* *       .1*       .3*
*FRS3          *   17501   *       .1*       .3*
*FRS3          *   17500   *       .1*       .3*
*FRS3          *   17495.3**       .1*       .3*
*FRS3          *   17490.6**       .1*       .3*
*FRS3          *   17486   *       .1*       .3*
*FRS3          *   17350   *       .1*       .3*
*FRS3          *   17050   *       .1*       .3*
*FRS3          *   16779   *       .1*       .3*
*FRS3          *   16774.* *       .1*       .3*
*FRS3          *   16769.* *       .1*       .3*
*FRS3          *   16764.* *       .1*       .3*
*FRS3          *   16759.* *       .1*       .3*
*FRS3          *   16754.* *       .1*       .3*
*FRS3          *   16749   *       .1*       .3*
*FRS3          *   16737   *       .1*       .3*
*FRS3          *   16731   *       .1*       .3*
*FRS3          *   16726.* *       .1*       .3*
*FRS3          *   16721.* *       .1*       .3*
*FRS3          *   16716.* *       .1*       .3*
*FRS3          *   16711.* *       .1*       .3*
*FRS3          *   16706.* *       .1*       .3*
*FRS3          *   16701   *       .1*       .3*
*FRS3          *   16700   *       .1*       .3*
*FRS3          *   16695.3**       .1*       .3*
*FRS3          *   16690.6**       .1*       .3*
*FRS3          *   16686   *       .1*       .3*
*FRS3          *   16500   *       .1*       .3*
*FRS3          *   16200   *       .1*       .3*
*FRS3          *   15984   *       .1*       .3*
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*FRS3          *   15979.4**      .1*       .3*
*FRS3          *   15974.9**      .1*       .3*
*FRS3          *   15970.4**      .1*       .3*
*FRS3          *   15965.8**      .1*       .3*
*FRS3          *   15961.3**      .1*       .3*
*FRS3          *   15956.8**      .1*       .3*
*FRS3          *   15952.2**      .1*       .3*
*FRS3          *   15947.7**      .1*       .3*
*FRS3          *   15943.2**      .1*       .3*
*FRS3          *   15938.7 *      .1*       .3*
*FRS3          *   15918.7 *      .1*       .3*
*FRS3          *   15918.6 *Culvert  *        *
*FRS3          *   15742.4 *      .1*       .3*
*FRS3          *   15741.4 *      .1*       .3*
*FRS3          *   15737.9**      .1*       .3*
*FRS3          *   15734.4**      .1*       .3*
*FRS3          *   15731   *      .1*       .3*
*FRS3          *   15591   *      .1*       .3*
*FRS3          *   15586.* *      .1*       .3*
*FRS3          *   15581.* *      .1*       .3*
*FRS3          *   15576.* *      .1*       .3*
*FRS3          *   15571.* *      .1*       .3*
*FRS3          *   15566.* *      .1*       .3*
*FRS3          *   15561   *      .1*       .3*
*FRS3          *   15537   *      .1*       .3*
*FRS3          *   15531   *      .1*       .3*
*FRS3          *   15526.* *      .1*       .3*
*FRS3          *   15521.* *      .1*       .3*
*FRS3          *   15516.* *      .1*       .3*
*FRS3          *   15511.* *      .1*       .3*
*FRS3          *   15506.* *      .1*       .3*
*FRS3          *   15501   *      .1*       .3*
*FRS3          *   15500   *      .1*       .3*
*FRS3          *   15495.* *      .1*       .3*
*FRS3          *   15490.* *      .1*       .3*
*FRS3          *   15485   *      .1*       .3*
*FRS3          *   15300   *      .1*       .3*
*FRS3          *   15081   *      .1*       .3*
*FRS3          *   15076.* *      .1*       .3*
*FRS3          *   15071.* *      .1*       .3*
*FRS3          *   15066.* *      .1*       .3*
*FRS3          *   15061.* *      .1*       .3*
*FRS3          *   15056.* *      .1*       .3*
*FRS3          *   15051.* *      .1*       .3*
*FRS3          *   15046   *      .1*       .3*
*FRS3          *   15042   *      .1*       .3*
*FRS3          *   15037.3**      .1*       .3*
*FRS3          *   15032.6**      .1*       .3*
*FRS3          *   15028.* *      .1*       .3*
*FRS3          *   15023.3**      .1*       .3*
*FRS3          *   15018.6**      .1*       .3*
*FRS3          *   15014.* *      .1*       .3*
*FRS3          *   15009.3**      .1*       .3*
*FRS3          *   15004.6**      .1*       .3*
*FRS3          *   15000   *      .1*       .3*
*FRS3          *   14600   *      .1*       .3*
*FRS3          *   14300   *      .1*       .3*
*FRS3          *   14295.* *      .1*       .3*
*FRS3          *   14290.* *      .1*       .3*
*FRS3          *   14285.* *      .1*       .3*
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*FRS3          *   2500    *       .1*       .3*
*FRS3          *   2200    *       .1*       .3*
*FRS3          *   1900    *       .1*       .3*
*FRS3          *   1568    *       .1*       .3*
*FRS3          *   1552    *       .1*       .3*
*FRS3          *   1500    *       .1*       .3*
*FRS3          *   1300    *       .1*       .3*
*FRS3          *   1000    *       .1*       .3*
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*FRS3          *   1000    *       .1*       .3*
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B.2 HEC-RAS MODEL - SUBCRITICAL FLOW ANALYSIS WITH N=0.035

Note: Required freeboard y=0.25(h+V2/2g), and 1-foot minimum for subcritical flow and 2-foot minimum for supercritical flow.

River Sta	Jackrabbit Trail Sta	Design Q (cfs)	Low Flow Elev (ft)	W.S. Elev (ft)	Bank Elevation (ft)	Flow Depth (ft)	Velocity (fps)	Froude Number	Required Free-board (ft)	Provided Free-board (ft)	Enough Free-board	Note
6200	10902	700	1082.12	1084.59	1088.12	2.47	7.94	1.00	2.00	3.53	YES	Concrete Channel
6550	11252	700	1083.13	1085.61	1089.13	2.48	6.88	0.81	1.00	3.52	YES	
6570	11272	700	1083.15	1086.57	1089.15	3.42	10.42	1.00	2.00	2.58	YES	
Culvert (Palm Ln)												
6663	11365	700	1083.60	1088.75	1091.60	5.15	8.46	0.66	1.57	2.85	YES	Concrete Drop Inlet
6673	11376	700	1084.60	1088.49	1092.60	3.89	11.23	1.01	2.00	4.11	YES	
6700	11402	700	1084.63	1090.57	1092.63	5.94	2.38	0.21	1.51	2.06	YES	
6800	11502	700	1084.73	1090.62	1092.73	5.89	2.65	0.25	1.50	2.11	YES	
6930	11632	700	1084.86	1090.71	1092.86	5.85	2.78	0.26	1.49	2.15	YES	Riprap
6945	11647	700	1084.87	1090.69	1092.87	5.82	3.34	0.26	1.50	2.18	YES	
6946	11648	700	1084.87	1090.73	1092.87	5.86	2.94	0.21	1.50	2.14	YES	Concrete Drop Structure
6976	11678	700	1084.90	1090.27	1092.90	5.37	7.22	0.55	1.54	2.63	YES	
6982	11684	700	1084.90	1090.10	1092.90	5.20	8.24	0.67	1.56	2.80	YES	
7000	11702	700	1087.90	1092.00	1095.90	4.10	10.76	1.00	2.00	3.90	YES	
7030	11732	700	1087.93	1093.90	1095.93	5.97	2.64	0.24	1.52	2.03	YES	Riprap
7150	11852	700	1088.05	1093.99	1096.05	5.94	2.68	0.25	1.51	2.06	YES	
7306	12008	700	1088.21	1094.10	1096.21	5.89	2.75	0.25	1.50	2.11	YES	Riprap
7321	12023	700	1088.22	1094.07	1096.22	5.85	3.31	0.26	1.51	2.15	YES	
7322	12024	700	1088.22	1094.12	1096.22	5.90	2.93	0.21	1.51	2.10	YES	Concrete Drop Structure
7352	12054	700	1088.25	1093.66	1096.25	5.41	7.16	0.54	1.55	2.59	YES	
7358	12060	700	1088.25	1093.50	1096.25	5.25	8.15	0.66	1.57	2.75	YES	
7376	12078	700	1091.25	1095.36	1099.25	4.11	10.75	1.00	2.00	3.89	YES	
7425	12127	700	1091.30	1097.27	1099.30	5.97	2.69	0.25	1.52	2.03	YES	Riprap
7700	12402	700	1091.58	1097.48	1099.58	5.90	2.76	0.25	1.50	2.10	YES	
7876	12578	700	1091.76	1097.62	1099.76	5.86	2.56	0.24	1.49	2.14	YES	
7885	12587	700	1091.76	1097.62	1099.76	5.86	2.63	0.21	1.49	2.14	YES	Riprap
7886	12588	700	1091.76	1097.65	1099.76	5.89	2.30	0.17	1.49	2.11	YES	Concrete Apron
7907	12609	700	1091.88	1096.89	1099.88	5.01	8.70	0.69	1.55	2.99	YES	
Culvert (Encanto Ave)												
7960	12662	700	1093.14	1098.29	1101.50	5.15	8.47	0.66	1.57	3.21	YES	Concrete Drop Inlet
7970	12672	700	1094.03	1097.92	1102.03	3.89	11.22	1.00	2.00	4.11	YES	
8004	12706	700	1094.05	1100.00	1102.05	5.95	2.62	0.24	1.51	2.05	YES	Riprap
8150	12852	700	1094.19	1100.09	1102.19	5.90	2.75	0.25	1.50	2.10	YES	
8325	13027	700	1094.37	1100.23	1102.37	5.86	2.79	0.26	1.50	2.14	YES	Riprap
8339	13041	700	1094.38	1100.20	1102.38	5.82	3.33	0.26	1.50	2.18	YES	
8340	13042	700	1094.38	1100.25	1102.38	5.87	2.94	0.21	1.50	2.13	YES	Concrete Drop Structure
8370	13072	700	1094.41	1099.78	1102.41	5.37	7.21	0.55	1.54	2.63	YES	
8376	13078	700	1094.41	1099.62	1102.41	5.21	8.22	0.67	1.56	2.79	YES	
8400	13102	700	1098.41	1102.51	1106.41	4.10	10.76	1.00	2.00	3.90	YES	
8437	13139	700	1098.45	1104.42	1106.45	5.97	2.70	0.25	1.52	2.03	YES	Riprap
8600	13302	700	1098.61	1104.54	1106.61	5.93	2.55	0.24	1.51	2.07	YES	
8733	13435	700	1098.75	1104.63	1106.75	5.88	2.76	0.25	1.50	2.12	YES	Riprap
8748	13450	700	1098.76	1104.61	1106.76	5.85	3.32	0.26	1.51	2.15	YES	
8749	13451	700	1098.76	1104.65	1106.76	5.89	2.93	0.21	1.51	2.11	YES	Concrete Drop Structure
8779	13481	700	1098.79	1104.19	1106.79	5.40	7.17	0.54	1.55	2.60	YES	
8785	13487	700	1098.79	1104.03	1106.79	5.24	8.17	0.66	1.57	2.76	YES	
8809	13511	700	1102.79	1106.90	1110.79	4.11	10.75	1.00	2.00	3.89	YES	
8863	13565	700	1102.84	1108.82	1110.84	5.98	2.74	0.25	1.52	2.02	YES	Riprap
9000	13702	700	1102.98	1108.92	1110.98	5.94	2.73	0.25	1.51	2.06	YES	
9183	13885	700	1103.17	1109.06	1111.17	5.89	2.64	0.24	1.50	2.11	YES	Riprap
9193	13894	700	1103.23	1109.07	1111.23	5.84	2.64	0.21	1.49	2.16	YES	Concrete Apron
9194	13895	700	1103.23	1109.09	1111.23	5.86	2.31	0.17	1.49	2.14	YES	
9218	13920	700	1103.23	1108.38	1111.23	5.15	8.46	0.66	1.57	2.85	YES	
Culvert (Virginia Ave)												
9272	13974	700	1106.97	1112.11	1114.99	5.14	8.47	0.66	1.56	2.88	YES	Riprap
9299	14001	700	1106.99	1113.28	1114.99	6.29	2.19	0.19	1.59	1.71	YES	
9450	14152	700	1107.12	1113.34	1115.12	6.22	2.50	0.22	1.58	1.78	YES	
9608	14310	700	1107.27	1113.43	1115.27	6.16	2.57	0.23	1.57	1.84	YES	
9623	14317	700	1107.35	1113.40	1115.35	6.05	3.19	0.24	1.55	1.95	YES	Riprap
9624	14325	700	1107.35	1113.44	1115.35	6.09	2.83	0.20	1.55	1.91	YES	
9654	14356	700	1107.35	1113.03	1115.35	5.68	6.82	0.51	1.60	2.32	YES	Concrete Drop Structure
9660	14362	700	1107.35	1112.90	1115.35	5.55	7.66	0.60	1.62	2.45	YES	
9675	14377	700	1109.85	1113.95	1117.85	4.10	10.76	1.00	2.00	3.90	YES	
9728	14430	700	1109.87	1115.87	1117.87	6.00	2.76	0.25	1.53	2.00	YES	Riprap
9900	14602	700	1110.04	1116.01	1118.04	5.97	2.54	0.24	1.52	2.03	YES	
10048	14750	700	1110.19	1116.11	1118.19	5.92	2.68	0.25	1.51	2.08	YES	Riprap
10063	14765	700	1110.20	1116.08	1118.20	5.88	3.29	0.26	1.51	2.12	YES	
10064	14766	700	1110.20	1116.12	1118.20	5.92	2.91	0.21	1.51	2.08	YES	Concrete Drop Structure
10094	14796	700	1110.23	1115.67	1118.23	5.44	7.11	0.54	1.56	2.56	YES	
10100	14802	700	1110.23	1115.52	1118.23	5.29	8.08	0.65	1.58	2.71	YES	
10124	14826	700	1114.23	1118.34	1122.23	4.11	10.75	1.00	2.00	3.89	YES	
10154	14856	700	1114.26	1120.23	1122.26	5.97	2.65	0.24	1.52	2.03	YES	Riprap
10350	15052	700	1114.46	1120.37	1122.46	5.91	2.67	0.25	1.51	2.09	YES	
10500	15202	700	1114.61	1120.48	1122.61	5.87	2.65	0.25	1.49	2.13	YES	
10510	15211	700	1114.63	1120.49	1122.63	5.86	2.63	0.21	1.49	2.14	YES	Riprap
10511	15212	700	1114.71	1120.52	1122.71	5.81	2.33	0.17	1.47	2.19	YES	Concrete Apron
10535	15237	700	1114.71	1119.78	1122.71	5.07	8.59	0.67	1.55	2.93	YES	
Culvert (Thomas Rd)												
10599	15301	700	1118.17	1123.31	1126.20	5.14	8.47	0.66	1.56	2.89	YES	Riprap
10645	15347	700	1118.20	1124.50	1126.20	6.30	2.10	0.18	1.59	1.70	YES	
10800	15502	700	1118.35	1124.55	1126.35	6.20	2.42	0.22	1.57	1.80	YES	
11017	15719	700	1118.56	1124.68	1126.56	6.12	2.58	0.23	1.56	1.88	YES	Riprap
11032	15733	700	1118.59	1124.65	1126.59	6.06	3.18	0.24	1.55	1.94	YES	
11033	15734	700	1118.59	1124.69	1126.59	6.10	2.83	0.20	1.56	1.90	YES	Concrete Drop Structure
11063	15764	700	1118.61	1124.27	1126.61	5.66	6.84	0.51	1.60	2.34	YES	
11069	15770	700	1118.61	1124.14	1126.61	5.53	7.69	0.61	1.61	2.47	YES	
11086	15787	700	1121.41	1125.51	1129.41	4.10	10.76	1.00	2.00	3.90	YES	
11133	15835	700	1121.45	1127.42	1129.45	5.97	2.83	0.26	1.52	2.03	YES	Riprap
11300	16002	700	1121.62	1127.56	1129.62	5.94	2.73	0.25	1.51	2.06	YES	

11484	16186	700	1121.80	1127.70	1129.80	5.90	2.76	0.25	1.50	2.10	YES	Riprap
11499	16201	700	1121.81	1127.67	1129.81	5.86	3.31	0.26	1.51	2.14	YES	
11500	16202	700	1121.81	1127.72	1129.81	5.91	2.92	0.21	1.51	2.09	YES	Concrete Drop Structure
11530	16232	700	1121.85	1127.26	1129.85	5.41	7.16	0.54	1.55	2.59	YES	
11536	16238	700	1121.85	1127.10	1129.85	5.25	8.15	0.66	1.57	2.75	YES	
11560	16262	700	1125.85	1129.96	1133.85	4.11	10.75	1.00	2.00	3.89	YES	
11590	16292	700	1125.88	1131.85	1133.88	5.97	2.71	0.25	1.52	2.03	YES	Riprap
11900	16602	700	1126.19	1132.08	1134.19	5.89	2.52	0.24	1.50	2.11	YES	
12164	16866	700	1126.45	1132.26	1134.45	5.81	2.82	0.26	1.48	2.19	YES	Riprap
12179	16881	700	1126.46	1132.24	1134.46	5.78	3.36	0.26	1.49	2.22	YES	
12180	16882	700	1126.46	1132.28	1134.46	5.82	2.96	0.22	1.49	2.18	YES	Concrete Drop Structure
12210	16912	700	1126.50	1131.81	1134.50	5.31	7.30	0.56	1.53	2.69	YES	
12216	16918	700	1126.50	1131.64	1134.50	5.14	8.36	0.69	1.56	2.86	YES	
12240	16942	700	1130.50	1134.61	1138.50	4.11	10.75	1.00	2.00	3.89	YES	
12270	16972	700	1130.53	1136.50	1138.53	5.97	2.71	0.25	1.52	2.03	YES	Riprap
12450	17152	700	1130.71	1136.64	1138.71	5.93	2.57	0.24	1.51	2.07	YES	
12665	17367	700	1130.92	1136.78	1138.92	5.86	2.78	0.26	1.50	2.14	YES	Riprap
12679	17381	700	1130.93	1136.76	1138.93	5.83	3.33	0.26	1.50	2.17	YES	
12680	17382	700	1130.93	1136.80	1138.93	5.87	2.94	0.21	1.50	2.13	YES	Concrete Drop Structure
12710	17412	700	1130.97	1136.47	1138.97	5.50	6.34	0.48	1.53	2.50	YES	
12716	17418	700	1130.97	1136.35	1138.97	5.38	7.14	0.57	1.54	2.62	YES	
12736	17438	700	1134.29	1138.15	1142.29	3.86	10.39	1.00	2.00	4.14	YES	
12767	17469	700	1134.34	1139.90	1141.34	5.56	2.79	0.26	1.42	1.44	YES	Riprap
12900	17602	700	1134.46	1140.03	1141.46	5.57	2.31	0.21	1.41	1.43	YES	
13100	17802	700	1134.76	1140.15	1141.76	5.39	2.48	0.23	1.37	1.61	YES	
13175	17877	700	1134.89	1140.09	1141.89	5.20	4.30	0.36	1.37	1.80	YES	
13185	17887	700	1135.99	1140.08	1142.99	4.09	4.67	0.41	1.11	2.91	YES	
Culvert (Osborn Rd)												
13235	17937	700	1135.87	1140.33	1142.87	4.46	4.22	0.36	1.18	2.54	YES	
13248	17950	700	1136.01	1140.34	1143.01	4.33	4.37	0.38	1.16	2.67	YES	
13266	17968	700	1139.67	1142.00	1146.67	2.33	8.44	1.01	2.00	4.67	YES	
13296	17998	700	1139.96	1143.11	1146.96	3.15	3.99	0.46	1.00	3.85	YES	
13600	18302	700	1140.28	1143.80	1147.28	3.52	3.12	0.33	1.00	3.48	YES	
13900	18602	700	1140.60	1144.22	1147.60	3.62	3.26	0.34	1.00	3.38	YES	
14100	18802	700	1140.80	1144.54	1147.80	3.74	3.49	0.38	1.00	3.26	YES	
14150	18852	700	1140.86	1144.49	1147.86	3.63	5.48	0.55	1.02	3.37	YES	
14175	18877	700	1141.28	1144.59	1148.28	3.31	5.51	0.55	1.00	3.69	YES	
Culvert (Clarendon Ave)												
14225	18927	700	1141.43	1145.11	1148.43	3.68	4.97	0.46	1.02	3.32	YES	
14238	18940	700	1141.44	1145.14	1148.44	3.70	5.03	0.46	1.02	3.30	YES	
14255	18957	700	1144.86	1147.19	1151.86	2.33	8.42	1.01	2.00	4.67	YES	
14300	19002	700	1145.30	1148.37	1152.30	3.07	4.48	0.53	1.00	3.93	YES	
14600	19302	700	1145.55	1149.19	1152.55	3.64	3.12	0.32	1.00	3.36	YES	
15000	19702	700	1145.98	1149.74	1152.98	3.76	3.19	0.33	1.00	3.24	YES	
15042	19744	700	1146.00	1149.35	1154.00	3.35	10.42	1.00	2.00	4.65	YES	
15046	19748	700	1146.41	1149.76	1154.41	3.35	10.42	1.00	2.00	4.65	YES	
15081	19783	700	1146.44	1151.52	1154.44	5.08	3.03	0.29	1.31	2.92	YES	
15300	20002	700	1146.66	1151.75	1154.66	5.09	3.02	0.29	1.31	2.91	YES	

15485	20187	700	1146.85	1151.94	1154.85	5.09	3.02	0.29	1.31	2.91	YES	Riprap
15500	20202	700	1146.85	1151.89	1154.85	5.04	3.94	0.34	1.32	2.96	YES	
15501	20203	700	1146.85	1151.96	1154.85	5.11	3.38	0.26	1.32	2.89	YES	Concrete Drop Structure
15531	20233	700	1146.89	1151.22	1154.89	4.33	8.94	0.76	1.39	3.67	YES	
15537	20239	700	1146.89	1150.99	1154.89	4.10	10.76	1.00	2.00	3.90	YES	
15561	20263	700	1150.89	1155.00	1158.89	4.11	10.75	1.00	2.00	3.89	YES	
15591	20293	700	1150.92	1156.91	1158.92	5.99	2.28	0.20	1.52	2.01	YES	Riprap
15731	20433	700	1151.06	1156.98	1159.06	5.92	2.27	0.20	1.50	2.08	YES	Riprap
15741	20443	700	1151.06	1156.97	1159.06	5.91	2.61	0.20	1.50	2.09	YES	Concrete Apron
15742	20444	700	1151.09	1157.00	1159.09	5.91	2.29	0.17	1.50	2.09	YES	
Culvert (Indian School Rd)												
15919	20620	700	1151.88	1157.23	1161.49	5.35	8.14	0.62	1.59	4.26	YES	Concrete Drop Inlet
15939	20640	700	1153.48	1157.37	1161.48	3.89	11.22	1.00	2.00	4.11	YES	
15984	20686	700	1153.52	1159.48	1161.52	5.96	2.31	0.21	1.51	2.04	YES	Riprap
16200	20902	800	1153.73	1159.59	1161.73	5.86	2.41	0.22	1.49	2.14	YES	
16500	21202	800	1154.03	1159.77	1162.03	5.74	2.75	0.25	1.46	2.26	YES	
16686	21388	800	1154.21	1159.91	1162.21	5.70	2.82	0.26	1.46	2.30	YES	Riprap
16700	21402	800	1154.22	1159.84	1162.22	5.62	3.97	0.32	1.47	2.38	YES	
16701	21403	800	1154.22	1159.90	1162.22	5.68	3.47	0.26	1.47	2.32	YES	Concrete Drop Structure
16731	21433	800	1154.26	1159.39	1162.26	5.13	7.77	0.61	1.52	2.87	YES	
16737	21439	800	1154.26	1159.17	1162.26	4.91	9.05	0.76	1.55	3.09	YES	
16749	21451	800	1156.26	1160.42	1164.26	4.16	10.91	1.01	2.00	3.84	YES	
16779	21481	800	1156.29	1162.38	1164.29	6.09	2.46	0.22	1.55	1.91	YES	Riprap
17050	21752	800	1156.56	1162.53	1164.56	5.97	2.59	0.23	1.52	2.03	YES	
17350	22052	800	1156.86	1162.73	1164.86	5.87	2.66	0.24	1.49	2.13	YES	
17486	22188	800	1156.99	1162.82	1164.99	5.83	2.73	0.25	1.49	2.17	YES	Riprap
17500	22202	800	1157.00	1162.75	1165.00	5.75	3.87	0.30	1.50	2.25	YES	
17501	22203	800	1157.00	1162.81	1165.00	5.81	3.39	0.25	1.50	2.19	YES	Concrete Drop Structure
17531	22233	800	1157.04	1162.33	1165.04	5.29	7.54	0.58	1.54	2.71	YES	
17537	22239	800	1157.04	1162.14	1165.04	5.10	8.68	0.71	1.57	2.90	YES	
17549	22251	800	1159.04	1163.20	1167.04	4.16	10.91	1.01	2.00	3.84	YES	
17579	22281	800	1159.07	1165.15	1167.07	6.08	2.53	0.22	1.54	1.92	YES	Riprap
17900	22602	800	1159.39	1165.35	1167.39	5.96	2.60	0.23	1.52	2.04	YES	
18200	22902	800	1159.69	1165.54	1167.69	5.85	2.66	0.24	1.49	2.15	YES	
18340	23033	800	1159.88	1164.53	1167.88	4.65	10.71	0.88	1.61	3.35	YES	Broken-Back Culvert
18920	23609	800	1161.06	1165.75	1169.06	4.69	10.63	0.87	1.61	3.31	YES	
18960	23640	800	1164.35	1168.63	1173.60	4.28	11.65	0.99	1.60	4.97	YES	
19252	23893	800	1165.42	1169.70	1173.42	4.28	11.65	0.99	1.60	3.72	YES	
19260	23900	800	1165.45	1171.60	1173.45	6.15	4.99	0.36	1.63	1.85	YES	
19267	23906	800	1165.45	1171.60	1173.45	6.15	4.99	0.36	1.63	1.85	YES	Concrete Drop Inlet
19277	23916	800	1166.45	1171.47	1174.45	5.02	6.12	0.48	1.40	2.98	YES	
19310	23940	800	1166.41	1171.99	1174.41	5.58	2.93	0.27	1.43	2.42	YES	Riprap
19650	24280	800	1166.73	1172.28	1174.73	5.55	2.62	0.24	1.41	2.45	YES	
19984	24614	800	1167.06	1172.53	1175.06	5.47	3.00	0.28	1.40	2.53	YES	Riprap
19999	24629	800	1167.07	1172.46	1175.07	5.39	4.16	0.34	1.41	2.61	YES	
20000	24630	800	1167.07	1172.54	1175.07	5.47	3.61	0.27	1.42	2.53	YES	Concrete Drop
20030	24660	800	1167.11	1171.95	1175.11	4.84	8.23	0.66	1.47	3.16	YES	

20036	24666	800	1167.11	1171.64	1175.11	4.53	9.89	0.87	1.51	3.47	YES	Structure
20048	24678	800	1169.11	1173.27	1177.11	4.16	10.90	1.01	2.00	3.84	YES	
20077	24707	800	1169.13	1175.23	1177.13	6.10	2.46	0.22	1.55	1.90	YES	Riprap
20300	24930	800	1169.36	1175.36	1177.36	6.00	2.35	0.21	1.52	2.00	YES	
20486	25116	800	1169.54	1175.46	1177.54	5.92	2.55	0.23	1.51	2.08	YES	Riprap
20501	25131	800	1169.55	1175.39	1177.55	5.84	3.80	0.30	1.52	2.16	YES	
20502	25132	800	1169.55	1175.44	1177.55	5.89	3.34	0.24	1.52	2.11	YES	Concrete Drop Structure
20532	25162	800	1169.59	1174.98	1177.59	5.39	7.39	0.56	1.56	2.61	YES	
20538	25168	800	1169.59	1174.81	1177.59	5.22	8.45	0.69	1.58	2.78	YES	
20550	25180	800	1171.59	1175.75	1179.59	4.16	10.91	1.01	2.00	3.84	YES	
20580	25210	800	1171.62	1177.71	1179.62	6.09	2.50	0.22	1.55	1.91	YES	Riprap
20850	25480	800	1171.89	1177.87	1179.89	5.98	2.39	0.21	1.52	2.02	YES	
21124	25754	800	1172.16	1178.02	1180.16	5.86	2.57	0.24	1.49	2.14	YES	Riprap
21135	25765	700	1172.19	1178.03	1180.19	5.84	2.64	0.21	1.49	2.16	YES	Concrete Apron
21136	25766	700	1172.50	1178.04	1180.50	5.54	2.44	0.18	1.41	2.46	YES	
Culvert (Camelback Rd)												
21275	25896	700	1173.05	1178.34	1183.91	5.29	8.22	0.63	1.58	5.57	YES	Concrete Drop Inlet
21308	25929	700	1175.91	1179.80	1183.91	3.89	11.22	1.00	2.00	4.11	YES	
21326	25956	700	1175.93	1181.85	1183.93	5.92	2.75	0.25	1.51	2.08	YES	Riprap
21600	26230	700	1176.13	1182.06	1184.13	5.93	2.74	0.25	1.51	2.07	YES	
21900	26530	700	1176.34	1182.28	1184.34	5.94	2.72	0.25	1.51	2.06	YES	
22200	26830	700	1176.55	1182.51	1184.55	5.96	2.71	0.25	1.52	2.04	YES	
22500	27130	700	1176.76	1182.73	1184.76	5.97	2.60	0.24	1.52	2.03	YES	
22615	27245	700	1176.84	1182.81	1184.84	5.97	2.59	0.24	1.52	2.03	YES	Riprap
22635	27265	700	1176.86	1182.69	1184.86	5.83	4.48	0.35	1.54	2.17	YES	
Culvert (Colter St)												
22711	27341	700	1177.68	1183.63	1188.90	5.95	4.37	0.33	1.56	5.27	YES	Riprap
22731	27361	700	1177.69	1183.88	1185.69	6.19	2.44	0.22	1.57	1.81	YES	
23000	27630	700	1177.88	1184.04	1185.88	6.16	2.57	0.23	1.57	1.84	YES	
23300	27930	700	1178.09	1184.23	1186.09	6.14	2.47	0.22	1.56	1.86	YES	
23619	28249	700	1178.31	1184.42	1186.31	6.11	2.61	0.24	1.55	1.89	YES	Riprap
23639	28269	700	1178.33	1184.31	1186.33	5.98	4.35	0.33	1.57	2.02	YES	
Culvert (Jackrabbit TR 2)												
24061	28590	700	1179.14	1185.23	1188.30	6.09	4.38	0.33	1.60	3.07	YES	Riprap
24081	28909	700	1179.16	1185.48	1187.16	6.32	2.31	0.21	1.60	1.68	YES	
24400	29209	500	1179.48	1185.64	1187.48	6.16	1.60	0.15	1.55	1.84	YES	
24700	29509	500	1179.78	1185.73	1187.78	5.95	1.79	0.17	1.50	2.05	YES	
25000	29704	500	1180.08	1185.83	1188.08	5.75	1.72	0.17	1.45	2.25	YES	
25195	29724	300	1180.28	1185.91	1188.28	5.63	1.25	0.12	1.41	2.37	YES	
25299	29808	300	1180.43	1185.92	1188.43	5.49	1.29	0.12	1.38	2.51	YES	
25600	30109	300	1180.73	1185.98	1188.73	5.25	1.42	0.14	1.32	2.75	YES	
25900	30409	300	1181.03	1186.06	1189.03	5.03	1.53	0.15	1.27	2.97	YES	
26200	30709	300	1181.33	1186.15	1189.33	4.82	1.63	0.16	1.22	3.18	YES	
26475	30984	300	1181.61	1186.25	1189.61	4.64	1.75	0.18	1.17	3.36	YES	Riprap
26495	31004	300	1181.63	1186.22	1189.63	4.59	2.52	0.22	1.17	3.41	YES	
Culvert (CIPP+HDPE)												
30801	35311	285	1187.13	1192.74	1195.13	5.61	2.94	0.22	1.44	2.39	YES	Riprap
30812	35321	285	1187.14	1192.85	1195.14	5.71	1.47	0.11	1.44	2.29	YES	
31000	35510	285	1187.33	1192.89	1194.33	5.56	0.24	0.02	1.39	1.44	YES	
31204	35713	285	1187.54	1192.87	1194.54	5.33	1.32	0.11	1.34	1.67	YES	
31216	35726	285	1187.55	1192.84	1194.55	5.29	2.27	0.17	1.34	1.71	YES	
31266	35776	285	1187.60	1192.77	1194.60	5.17	3.66	0.28	1.34	1.83	YES	

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                    HEC-RAS Version 4.1.0 Jan 2010
                     U.S. Army Corps of Engineers
                    Hydrologic Engineering Center
                          609 Second Street
                          Davis, California

          X     X  XXXXXX    XXXX        XXXX       XX      XXXX
          X     X  X        X    X       X   X     X  X    X
          X     X  X        X            X   X    X    X   X
          XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
          X     X  X        X            X  X     X    X        X
          X     X  X        X    X       X   X    X    X        X
          X     X  XXXXXX    XXXX        X    X   X    X   XXXXX

*****************************************************************************
PROJECT DATA
Project Title: FRS3 Outlet Channel
Project File : WTO3SUB1.prj
Run Date and Time: 2/3/2011 5:59:08 PM

Project in English units

Project Description:
Project: White Tanks FRS #3 Outlet Channel Final Design

Prepared by:
Hoskin
Ryan Consultants

Prepared for:
Flood Control District of Maricopa
County

Storm Event: 100-Year
Manning's n for earthen channel were set at
0.035, for the design condition.
Discharges were obtained from the HEC-1 model
prepared for this project.

River station is along the alignment of channel.
Jackrabbit Trail station is also provided for cross-sections in the
description.

River station is along the channel alignment.  Jackrabbit Trail
station is also provided for cross-sections in the description.

*****************************************************************************
PLAN DATA

Plan Title: Subcritical Flow Calc
Plan File : G:\Projects\09\09-077 WTO3 Final\08 - 100% Design B\Hydro\HEC-RAS\WTO3SUB1.p01

          Geometry Title: Final Design
          Geometry File : G:\Projects\09\09-077 WTO3 Final\08 - 100% Design B\Hydro\HEC-RAS\WTO3SUB1.g01

          Flow Title    : 100-year design flow
          Flow File     : G:\Projects\09\09-077 WTO3 Final\08 - 100% Design B\Hydro\HEC-RAS\WTO3SUB1.f01

Plan Description:
Subcritical flow with Manning's n=0.035


Plan Summary Information:
Number of:  Cross Sections =  258    Multiple Openings  =    0
            Culverts       =   14    Inline Structures  =    0
            Bridges        =    0    Lateral Structures =    0

Computational Information
    Water surface calculation tolerance  =  0.01
    Critical depth calculation tolerance =  0.01
    Maximum number of iterations         =  20
    Maximum difference tolerance         =  0.3
    Flow tolerance factor                =  0.001

Computation Options
    Critical depth computed only where necessary
    Conveyance Calculation Method: At breaks in n values only
    Friction Slope Method:         Average Conveyance
```

```
    Computational Flow Regime:     Subcritical Flow

*****************************************************************************
FLOW DATA

Flow Title: 100-year design flow
Flow File : G:\Projects\09\09-077 WTO3 Final\08 - 100% Design B\Hydro\HEC-RAS\WTO3SUB1.f01

Flow Data (cfs)
*************************************************************
* River          Reach          RS        *        N=0.035 *
* Channel        FRS3           31266.2   *            285 *
* Channel        FRS3           26495     *            300 *
* Channel        FRS3           25000     *            500 *
* Channel        FRS3           24081     *            700 *
* Channel        FRS3           21124     *            800 *
* Channel        FRS3           15984     *            700 *
* Channel        FRS3           5400      *           1328 *
* Channel        FRS3           4748      *           1549 *
*************************************************************

Boundary Conditions
*****************************************************************************************************
* River          Reach          Profile          *          Upstream                Downstream    *
*****************************************************************************************************
* Channel        FRS3           N=0.035          *        Normal S = 0.001       Known WS = 1052.1 *
*****************************************************************************************************
Inline Structure Gate Openings
River = Channel
Reach = FRS3                RS = 30790
Gate  = Slide Gate
  # Open Open Ht
****************
       5       2

*****************************************************************************
SUMMARY OF MANNING'S N VALUES

River:Channel
*****************************************************************
*     Reach       *   River Sta.   *   n1    *   n2    *   n3    *
*****************************************************************
*FRS3             *   31266.2      *    .045*    .015*    .045*
*FRS3             *   31216.2      *    .045*    .035*    .045*
*FRS3             *   31203.5      *    .045*    .035*    .045*
*FRS3             *   31000        *    .045*    .035*    .045*
*FRS3             *   30811.5      *    .045*    .035*    .045*
*FRS3             *   30801.1      *    .045*    .035*    .045*
*FRS3             *   30801        *Culvert  *       *       *
*FRS3             *   26495        *    .045*    .035*    .045*
*FRS3             *   26475        *    .045*    .035*    .045*
*FRS3             *   26200        *    .045*    .035*    .045*
*FRS3             *   25900        *    .045*    .035*    .045*
*FRS3             *   25600        *    .045*    .035*    .045*
*FRS3             *   25299        *    .045*    .035*    .045*
*FRS3             *   25195        *    .045*    .035*    .045*
*FRS3             *   25000        *    .045*    .035*    .045*
*FRS3             *   24700        *    .045*    .035*    .045*
*FRS3             *   24400        *    .045*    .035*    .045*
*FRS3             *   24081        *    .045*    .035*    .045*
*FRS3             *   24061        *    .045*    .035*    .045*
*FRS3             *   24052.5      *Culvert  *       *       *
*FRS3             *   23639        *    .045*    .035*    .045*
*FRS3             *   23619        *    .045*    .035*    .045*
*FRS3             *   23300        *    .045*    .035*    .045*
*FRS3             *   23000        *    .045*    .035*    .045*
*FRS3             *   22731        *    .045*    .035*    .045*
*FRS3             *   22711        *    .045*    .035*    .045*
*FRS3             *   22704.4      *Culvert  *       *       *
*FRS3             *   22635        *    .045*    .035*    .045*
*FRS3             *   22615        *    .045*    .035*    .045*
*FRS3             *   22500        *    .045*    .035*    .045*
*FRS3             *   22200        *    .045*    .035*    .045*
*FRS3             *   21900        *    .045*    .035*    .045*
*FRS3             *   21600        *    .045*    .035*    .045*
*FRS3             *   21326        *    .045*    .035*    .045*
*FRS3             *   21307.8      *    .045*    .015*    .045*
*FRS3             *   21274.9      *    .045*    .015*    .045*
*FRS3             *   21265.8      *Culvert  *       *       *
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*FRS3	*	21136	*	.045*	.015*	.045*
*FRS3	*	21135	*	.045*	.035*	.045*
*FRS3	*	21124	*	.045*	.035*	.045*
*FRS3	*	20850	*	.045*	.035*	.045*
*FRS3	*	20580	*	.045*	.035*	.045*
*FRS3	*	20550	*	.045*	.015*	.045*
*FRS3	*	20538	*	.045*	.015*	.045*
*FRS3	*	20532	*	.045*	.015*	.045*
*FRS3	*	20502	*	.045*	.015*	.045*
*FRS3	*	20501	*	.045*	.035*	.045*
*FRS3	*	20486	*	.045*	.035*	.045*
*FRS3	*	20300	*	.045*	.035*	.045*
*FRS3	*	20077	*	.045*	.035*	.045*
*FRS3	*	20048	*	.045*	.015*	.045*
*FRS3	*	20036	*	.045*	.015*	.045*
*FRS3	*	20030	*	.045*	.015*	.045*
*FRS3	*	20000	*	.045*	.015*	.045*
*FRS3	*	19999	*	.045*	.035*	.045*
*FRS3	*	19984	*	.045*	.035*	.045*
*FRS3	*	19650	*	.045*	.035*	.045*
*FRS3	*	19310	*	.045*	.035*	.045*
*FRS3	*	19277	*	.045*	.015*	.045*
*FRS3	*	19267	*	.045*	.015*	.045*
*FRS3	*	19260	*	.013*	.013*	.013*
*FRS3	*	19251.7	*	.013*	.013*	.013*
*FRS3	*	18960	*	.013*	.013*	.013*
*FRS3	*	18920	*	.013*	.013*	.013*
*FRS3	*	18340	*	.013*	.013*	.013*
*FRS3	*	18200	*	.045*	.035*	.045*
*FRS3	*	17900	*	.045*	.035*	.045*
*FRS3	*	17579	*	.045*	.035*	.045*
*FRS3	*	17549	*	.045*	.015*	.045*
*FRS3	*	17537	*	.045*	.015*	.045*
*FRS3	*	17531	*	.045*	.015*	.045*
*FRS3	*	17501	*	.045*	.015*	.045*
*FRS3	*	17500	*	.045*	.035*	.045*
*FRS3	*	17486	*	.045*	.035*	.045*
*FRS3	*	17350	*	.045*	.035*	.045*
*FRS3	*	17050	*	.045*	.035*	.045*
*FRS3	*	16779	*	.045*	.035*	.045*
*FRS3	*	16749	*	.045*	.015*	.045*
*FRS3	*	16737	*	.045*	.015*	.045*
*FRS3	*	16731	*	.045*	.015*	.045*
*FRS3	*	16701	*	.045*	.015*	.045*
*FRS3	*	16700	*	.045*	.035*	.045*
*FRS3	*	16686	*	.045*	.035*	.045*
*FRS3	*	16500	*	.045*	.035*	.045*
*FRS3	*	16200	*	.045*	.035*	.045*
*FRS3	*	15984	*	.045*	.035*	.045*
*FRS3	*	15938.7	*	.045*	.015*	.045*
*FRS3	*	15918.7	*	.045*	.015*	.045*
*FRS3	*	15918.6	*Culvert	*	*	*
*FRS3	*	15742.4	*	.045*	.015*	.045*
*FRS3	*	15741.4	*	.045*	.035*	.045*
*FRS3	*	15731	*	.045*	.035*	.045*
*FRS3	*	15591	*	.045*	.035*	.045*
*FRS3	*	15561	*	.045*	.015*	.045*
*FRS3	*	15537	*	.045*	.015*	.045*
*FRS3	*	15531	*	.045*	.015*	.045*
*FRS3	*	15501	*	.045*	.015*	.045*
*FRS3	*	15500	*	.045*	.035*	.045*
*FRS3	*	15485	*	.045*	.035*	.045*
*FRS3	*	15300	*	.045*	.035*	.045*
*FRS3	*	15081	*	.045*	.035*	.045*
*FRS3	*	15046	*	.045*	.015*	.045*
*FRS3	*	15042	*	.045*	.015*	.045*
*FRS3	*	15000	*	.045*	.035*	.045*
*FRS3	*	14600	*	.045*	.035*	.045*
*FRS3	*	14300	*	.045*	.035*	.045*
*FRS3	*	14255	*	.045*	.035*	.045*
*FRS3	*	14238	*	.045*	.035*	.045*
*FRS3	*	14225	*	.045*	.035*	.045*
*FRS3	*	14223.6	*Culvert	*	*	*
*FRS3	*	14175	*	.045*	.035*	.045*
*FRS3	*	14150	*	.045*	.035*	.045*
*FRS3	*	14100	*	.045*	.035*	.045*
*FRS3	*	13900	*	.045*	.035*	.045*
*FRS3	*	13600	*	.045*	.035*	.045*
*FRS3	*	13296	*	.045*	.035*	.045*
*FRS3	*	13266	*	.045*	.035*	.045*
*FRS3	*	13248	*	.045*	.035*	.045*
*FRS3	*	13235	*	.045*	.035*	.045*
*FRS3	*	13233.5	*Culvert	*	*	*
*FRS3	*	13185	*	.045*	.035*	.045*
*FRS3	*	13175	*	.045*	.035*	.045*
*FRS3	*	13100	*	.045*	.035*	.045*
*FRS3	*	12900	*	.045*	.035*	.045*
*FRS3	*	12767	*	.045*	.035*	.045*
*FRS3	*	12736	*	.045*	.015*	.045*
*FRS3	*	12716	*	.045*	.015*	.045*
*FRS3	*	12710	*	.045*	.015*	.045*
*FRS3	*	12680	*	.045*	.015*	.045*
*FRS3	*	12679	*	.045*	.035*	.045*
*FRS3	*	12665	*	.045*	.035*	.045*
*FRS3	*	12450	*	.045*	.035*	.045*
*FRS3	*	12270	*	.045*	.035*	.045*
*FRS3	*	12240	*	.045*	.015*	.045*
*FRS3	*	12216	*	.045*	.015*	.045*
*FRS3	*	12210	*	.045*	.015*	.045*
*FRS3	*	12180	*	.045*	.015*	.045*
*FRS3	*	12179	*	.045*	.035*	.045*
*FRS3	*	12164	*	.045*	.035*	.045*
*FRS3	*	11900	*	.045*	.035*	.045*
*FRS3	*	11590	*	.045*	.035*	.045*
*FRS3	*	11560	*	.045*	.015*	.045*
*FRS3	*	11536	*	.045*	.015*	.045*
*FRS3	*	11530	*	.045*	.015*	.045*
*FRS3	*	11500	*	.045*	.015*	.045*
*FRS3	*	11499	*	.045*	.035*	.045*
*FRS3	*	11484	*	.045*	.035*	.045*
*FRS3	*	11300	*	.045*	.035*	.045*
*FRS3	*	11133	*	.045*	.035*	.045*
*FRS3	*	11085.5	*	.045*	.015*	.045*
*FRS3	*	11068.7	*	.045*	.015*	.045*
*FRS3	*	11062.7	*	.045*	.015*	.045*
*FRS3	*	11032.7	*	.045*	.015*	.045*
*FRS3	*	11031.7	*	.045*	.035*	.045*
*FRS3	*	11017.2	*	.045*	.035*	.045*
*FRS3	*	10800	*	.045*	.035*	.045*
*FRS3	*	10645	*	.045*	.035*	.045*
*FRS3	*	10599.1	*	.045*	.015*	.045*
*FRS3	*	10598	*Culvert	*	*	*
*FRS3	*	10535.1	*	.045*	.015*	.045*
*FRS3	*	10510.8	*	.045*	.015*	.045*
*FRS3	*	10509.8	*	.045*	.035*	.045*
*FRS3	*	10500	*	.045*	.035*	.045*
*FRS3	*	10350	*	.045*	.035*	.045*
*FRS3	*	10154	*	.045*	.035*	.045*
*FRS3	*	10124	*	.045*	.015*	.045*
*FRS3	*	10100	*	.045*	.015*	.045*
*FRS3	*	10094	*	.045*	.015*	.045*
*FRS3	*	10064	*	.045*	.015*	.045*
*FRS3	*	10063	*	.045*	.035*	.045*
*FRS3	*	10048	*	.045*	.035*	.045*
*FRS3	*	9900	*	.045*	.035*	.045*
*FRS3	*	9728	*	.045*	.035*	.045*
*FRS3	*	9675	*	.045*	.015*	.045*
*FRS3	*	9660	*	.045*	.015*	.045*
*FRS3	*	9654	*	.045*	.015*	.045*
*FRS3	*	9624	*	.045*	.015*	.045*
*FRS3	*	9623	*	.045*	.035*	.045*
*FRS3	*	9608	*	.045*	.035*	.045*
*FRS3	*	9450	*	.045*	.035*	.045*
*FRS3	*	9299	*	.045*	.035*	.045*
*FRS3	*	9272.1	*	.045*	.015*	.045*
*FRS3	*	9272	*Culvert	*	*	*
*FRS3	*	9218.1	*	.045*	.015*	.045*
*FRS3	*	9193.8	*	.045*	.015*	.045*
*FRS3	*	9192.8	*	.045*	.035*	.045*
*FRS3	*	9183	*	.045*	.035*	.035*
*FRS3	*	9000	*	.045*	.035*	.045*
*FRS3	*	8863	*	.045*	.035*	.045*
*FRS3	*	8809	*	.045*	.015*	.045*
*FRS3	*	8785	*	.045*	.015*	.045*
*FRS3	*	8779	*	.045*	.015*	.045*
*FRS3	*	8749	*	.045*	.015*	.045*
*FRS3	*	8748	*	.045*	.035*	.045*
*FRS3	*	8733	*	.045*	.035*	.045*
*FRS3	*	8600	*	.045*	.035*	.045*
*FRS3	*	8437	*	.045*	.035*	.045*

*FRS3	8400	.045	.015	.045
*FRS3	8376	.045	.015	.045
*FRS3	8370	.045	.015	.045
*FRS3	8340	.045	.015	.045
*FRS3	8339	.045	.035	.045
*FRS3	8325	.045	.035	.045
*FRS3	8150	.045	.035	.045
*FRS3	8004	.045	.035	.045
*FRS3	7970.4	.045	.015	.045
*FRS3	7960.4	.045	.015	.045
*FRS3	7958.2	Culvert		
*FRS3	7907.3	.045	.015	.045
*FRS3	7886	.045	.015	.045
*FRS3	7885	.045	.035	.045
*FRS3	7876	.045	.035	.045
*FRS3	7700	.045	.035	.045
*FRS3	7425	.045	.035	.045
*FRS3	7376	.045	.015	.045
*FRS3	7358	.045	.015	.045
*FRS3	7352	.045	.015	.045
*FRS3	7322	.045	.015	.045
*FRS3	7321	.045	.035	.045
*FRS3	7306	.045	.035	.045
*FRS3	7150	.045	.035	.045
*FRS3	7030	.045	.035	.045
*FRS3	7000	.045	.015	.045
*FRS3	6982	.045	.015	.045
*FRS3	6976	.045	.015	.045
*FRS3	6946	.045	.015	.045
*FRS3	6945	.045	.035	.045
*FRS3	6930	.045	.035	.045
*FRS3	6800	.045	.035	.045
*FRS3	6700	.045	.035	.045
*FRS3	6673.16	.045	.015	.045
*FRS3	6663.16	.045	.015	.045
*FRS3	6661.6	Culvert		
*FRS3	6570	.035	.015	.035
*FRS3	6550	.035	.015	.035
*FRS3	6200	.035	.015	.035
*FRS3	5920	.035	.015	.035
*FRS3	5902	.035	.015	.035
*FRS3	5600	.035	.015	.035
*FRS3	5400	.035	.015	.035
*FRS3	5342.1	Culvert		
*FRS3	5220	.035	.015	.035
*FRS3	5193	.035	.015	.035
*FRS3	5181	.035	.015	.035
*FRS3	5100	.035	.015	.035
*FRS3	4800	.035	.015	.035
*FRS3	4748	.035	.015	.035
*FRS3	4740	.035	.015	.035
*FRS3	4729.5	Culvert		
*FRS3	4650	.035	.015	.035
*FRS3	4600	.035	.015	.035
*FRS3	4350	.035	.015	.035
*FRS3	4278	.035	.015	.035
*FRS3	4271	Culvert		
*FRS3	4200	.035	.015	.035
*FRS3	4183	.035	.015	.035
*FRS3	4168	.035	.015	.035
*FRS3	4100	.035	.015	.035
*FRS3	3800	.035	.015	.035
*FRS3	3500	.035	.015	.035
*FRS3	3200	.035	.015	.035
*FRS3	2903	.035	.015	.035
*FRS3	2885	.035	.015	.035
*FRS3	2800	.035	.015	.035
*FRS3	2500	.035	.015	.035
*FRS3	2200	.035	.015	.035
*FRS3	1900	.035	.015	.035
*FRS3	1568	.035	.015	.035
*FRS3	1552	.035	.015	.035
*FRS3	1500	.035	.015	.035
*FRS3	1300	.035	.015	.035
*FRS3	1000	.035	.015	.035

SUMMARY OF REACH LENGTHS

River: Channel

Reach	River Sta.	Left	Channel	Right
*FRS3	31266.2	50	50	50
*FRS3	31216.2	12.7	12.7	12.7
*FRS3	31203.5	203.5	203.5	203.5
*FRS3	31000	188.5	188.5	188.5
*FRS3	30811.5	10.4	10.4	10.4
*FRS3	30801.1	4306.1	4306.1	4306.1
*FRS3	30801	Culvert		
*FRS3	26495	20	20	20
*FRS3	26475	275	275	275
*FRS3	26200	300	300	300
*FRS3	25900	300	300	300
*FRS3	25600	301	301	301
*FRS3	25299	104	104	104
*FRS3	25195	195	195	195
*FRS3	25000	300	300	300
*FRS3	24700	300	300	300
*FRS3	24400	319	319	319
*FRS3	24081	20	20	20
*FRS3	24061	422	422	422
*FRS3	24052.5	Culvert		
*FRS3	23639	20	20	20
*FRS3	23619	319	319	319
*FRS3	23300	300	300	300
*FRS3	23000	269	269	269
*FRS3	22731	20	20	20
*FRS3	22711	76	76	76
*FRS3	22704.4	Culvert		
*FRS3	22635	20	20	20
*FRS3	22615	115	115	115
*FRS3	22500	300	300	300
*FRS3	22200	300	300	300
*FRS3	21900	300	300	300
*FRS3	21600	274	274	274
*FRS3	21326	18.2	18.2	18.2
*FRS3	21307.8	32.9	32.9	32.9
*FRS3	21274.9	138.9	138.9	138.9
*FRS3	21265.8	Culvert		
*FRS3	21136	1	1	1
*FRS3	21135	20	11	20
*FRS3	21124	274	274	274
*FRS3	20850	270	270	270
*FRS3	20580	30	30	30
*FRS3	20550	12	12	12
*FRS3	20538	6	6	6
*FRS3	20532	30	30	30
*FRS3	20502	1	1	1
*FRS3	20501	20	15	20
*FRS3	20486	186	186	186
*FRS3	20300	223	223	223
*FRS3	20077	29	29	29
*FRS3	20048	12	12	12
*FRS3	20036	6	6	6
*FRS3	20030	30	30	30
*FRS3	20000	1	1	1
*FRS3	19999	20	15	20
*FRS3	19984	334	334	334
*FRS3	19650	340	340	340
*FRS3	19310	33	33	33
*FRS3	19277	10	10	10
*FRS3	19267	7	7	7
*FRS3	19260	8.3	8.3	8.3
*FRS3	19251.7	291.7	291.7	291.7
*FRS3	18960	40	40	40
*FRS3	18920	580	580	580
*FRS3	18340	140	140	140
*FRS3	18200	300	300	300
*FRS3	17900	321	321	321
*FRS3	17579	30	30	30
*FRS3	17549	12	12	12
*FRS3	17537	6	6	6
*FRS3	17531	30	30	30
*FRS3	17501	1	1	1
*FRS3	17500	20	14	20
*FRS3	17486	136	136	136
*FRS3	17350	300	300	300
*FRS3	17050	271	271	271

*FRS3	*	16779	*	30*	30*	30*
*FRS3	*	16749	*	12*	12*	12*
*FRS3	*	16737	*	6*	6*	6*
*FRS3	*	16731	*	5.73*	30*	30*
*FRS3	*	16701	*	1*	1*	1*
*FRS3	*	16700	*	20*	14*	20*
*FRS3	*	16686	*	186*	186*	186*
*FRS3	*	16500	*	300*	300*	300*
*FRS3	*	16200	*	216*	216*	216*
*FRS3	*	15984	*	45.3*	45.3*	45.3*
*FRS3	*	15938.7	*	20*	20*	20*
*FRS3	*	15918.7	*	176.3*	176.3*	176.3*
*FRS3	*	15918.6	*Culvert	*	*	*
*FRS3	*	15742.4	*	1*	1*	1*
*FRS3	*	15741.4	*	20*	10.4*	20*
*FRS3	*	15731	*	140*	140*	140*
*FRS3	*	15591	*	30*	30*	30*
*FRS3	*	15561	*	24*	24*	24*
*FRS3	*	15537	*	6*	6*	6*
*FRS3	*	15531	*	30*	30*	30*
*FRS3	*	15501	*	1*	1*	1*
*FRS3	*	15500	*	20*	15*	20*
*FRS3	*	15485	*	185*	185*	185*
*FRS3	*	15300	*	219*	219*	219*
*FRS3	*	15081	*	35*	35*	35*
*FRS3	*	15046	*	4*	4*	4*
*FRS3	*	15042	*	42*	42*	42*
*FRS3	*	15000	*	400*	400*	400*
*FRS3	*	14600	*	300*	300*	300*
*FRS3	*	14300	*	45*	45*	45*
*FRS3	*	14255	*	17*	17*	17*
*FRS3	*	14238	*	13*	13*	13*
*FRS3	*	14225	*	50*	50*	50*
*FRS3	*	14223.6	*Culvert	*	*	*
*FRS3	*	14175	*	25*	25*	25*
*FRS3	*	14150	*	50*	50*	50*
*FRS3	*	14100	*	200*	200*	200*
*FRS3	*	13900	*	300*	300*	300*
*FRS3	*	13600	*	304*	304*	304*
*FRS3	*	13296	*	30*	30*	30*
*FRS3	*	13266	*	18*	18*	18*
*FRS3	*	13248	*	13*	13*	13*
*FRS3	*	13235	*	50*	50*	50*
*FRS3	*	13233.5	*Culvert	*	*	*
*FRS3	*	13185	*	10*	10*	10*
*FRS3	*	13175	*	75*	75*	75*
*FRS3	*	13100	*	200*	200*	200*
*FRS3	*	12900	*	133*	133*	133*
*FRS3	*	12767	*	31*	31*	31*
*FRS3	*	12736	*	20*	20*	20*
*FRS3	*	12716	*	6*	6*	6*
*FRS3	*	12710	*	30*	30*	30*
*FRS3	*	12680	*	1*	1*	1*
*FRS3	*	12679	*	20*	14*	20*
*FRS3	*	12665	*	215*	215*	215*
*FRS3	*	12450	*	180*	180*	180*
*FRS3	*	12270	*	30*	30*	30*
*FRS3	*	12240	*	24*	24*	24*
*FRS3	*	12216	*	6*	6*	6*
*FRS3	*	12210	*	30*	30*	30*
*FRS3	*	12180	*	1*	1*	1*
*FRS3	*	12179	*	20*	15*	20*
*FRS3	*	12164	*	264*	264*	264*
*FRS3	*	11900	*	310*	310*	310*
*FRS3	*	11590	*	30*	30*	30*
*FRS3	*	11560	*	24*	24*	24*
*FRS3	*	11536	*	6*	6*	6*
*FRS3	*	11530	*	30*	30*	30*
*FRS3	*	11500	*	1*	1*	1*
*FRS3	*	11499	*	20*	15*	20*
*FRS3	*	11484	*	184*	184*	184*
*FRS3	*	11300	*	167*	167*	167*
*FRS3	*	11133	*	47.5*	47.5*	47.5*
*FRS3	*	11085.5	*	16.8*	16.8*	16.8*
*FRS3	*	11068.7	*	6*	6*	6*
*FRS3	*	11062.7	*	30*	30*	30*
*FRS3	*	11032.7	*	1*	1*	1*
*FRS3	*	11031.7	*	20*	14.5*	20*
*FRS3	*	11017.2	*	217.2*	217.2*	217.2*
*FRS3	*	10800	*	155*	155*	155*
*FRS3	*	10645	*	45.9*	45.9*	45.9*
*FRS3	*	10599.1	*	64*	64*	64*
*FRS3	*	10598	*Culvert	*	*	*
*FRS3	*	10535.1	*	24.3*	24.3*	24.3*
*FRS3	*	10510.8	*	1*	1*	1*
*FRS3	*	10509.8	*	20*	9.8*	20*
*FRS3	*	10500	*	150*	150*	150*
*FRS3	*	10350	*	196*	196*	196*
*FRS3	*	10154	*	30*	30*	30*
*FRS3	*	10124	*	24*	24*	24*
*FRS3	*	10100	*	6*	6*	6*
*FRS3	*	10094	*	30*	30*	30*
*FRS3	*	10064	*	1*	1*	1*
*FRS3	*	10063	*	20*	15*	20*
*FRS3	*	10048	*	148*	148*	148*
*FRS3	*	9900	*	172*	172*	172*
*FRS3	*	9728	*	53*	53*	53*
*FRS3	*	9675	*	15*	15*	15*
*FRS3	*	9660	*	6*	6*	6*
*FRS3	*	9654	*	30*	30*	30*
*FRS3	*	9624	*	1*	1*	1*
*FRS3	*	9623	*	20*	15*	20*
*FRS3	*	9608	*	158*	158*	158*
*FRS3	*	9450	*	151*	151*	151*
*FRS3	*	9299	*	26.9*	26.9*	26.9*
*FRS3	*	9272.1	*	54*	54*	54*
*FRS3	*	9272	*Culvert	*	*	*
*FRS3	*	9218.1	*	24.3*	24.3*	24.3*
*FRS3	*	9193.8	*	1*	1*	1*
*FRS3	*	9192.8	*	20*	9.8*	20*
*FRS3	*	9183	*	183*	183*	183*
*FRS3	*	9000	*	137*	137*	137*
*FRS3	*	8863	*	54*	54*	54*
*FRS3	*	8809	*	24*	24*	24*
*FRS3	*	8785	*	6*	6*	6*
*FRS3	*	8779	*	30*	30*	30*
*FRS3	*	8749	*	1*	1*	1*
*FRS3	*	8748	*	20*	15*	20*
*FRS3	*	8733	*	133*	133*	133*
*FRS3	*	8600	*	163*	163*	163*
*FRS3	*	8437	*	37*	37*	37*
*FRS3	*	8400	*	24*	24*	24*
*FRS3	*	8376	*	6*	6*	6*
*FRS3	*	8370	*	30*	30*	30*
*FRS3	*	8340	*	1*	1*	1*
*FRS3	*	8339	*	20*	14*	20*
*FRS3	*	8325	*	175*	175*	175*
*FRS3	*	8150	*	146*	146*	146*
*FRS3	*	8004	*	33.6*	33.6*	33.6*
*FRS3	*	7970.4	*	10*	10*	10*
*FRS3	*	7960.4	*	53.1*	53.1*	53.1*
*FRS3	*	7958.2	*Culvert	*	*	*
*FRS3	*	7907.3	*	21.3*	21.3*	21.3*
*FRS3	*	7886	*	1*	1*	1*
*FRS3	*	7885	*	19*	9*	19*
*FRS3	*	7876	*	176*	176*	176*
*FRS3	*	7700	*	275*	275*	275*
*FRS3	*	7425	*	49*	49*	49*
*FRS3	*	7376	*	18*	18*	18*
*FRS3	*	7358	*	6*	6*	6*
*FRS3	*	7352	*	30*	30*	30*
*FRS3	*	7322	*	1*	1*	1*
*FRS3	*	7321	*	20*	15*	20*
*FRS3	*	7306	*	156*	156*	156*
*FRS3	*	7150	*	120*	120*	120*
*FRS3	*	7030	*	30*	30*	30*
*FRS3	*	7000	*	18*	18*	18*
*FRS3	*	6982	*	6*	6*	6*
*FRS3	*	6976	*	30*	30*	30*
*FRS3	*	6946	*	1*	1*	1*
*FRS3	*	6945	*	20*	15*	20*
*FRS3	*	6930	*	130*	130*	130*
*FRS3	*	6800	*	100*	100*	100*
*FRS3	*	6700	*	26.84*	26.84*	26.84*
*FRS3	*	6673.16	*	10*	10*	10*
*FRS3	*	6663.16	*	93.16*	93.16*	93.16*
*FRS3	*	6661.6	*Culvert	*	*	*
*FRS3	*	6570	*	20*	20*	20*
*FRS3	*	6550	*	350*	350*	350*
*FRS3	*	6200	*	280*	280*	280*

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*FRS3          *   5920       *      18*       18*       18*
*FRS3          *   5902       *     302*      302*      302*
*FRS3          *   5600       *     200*      200*      200*
*FRS3          *   5400       *     180*      180*      180*
*FRS3          *   5342.1     *Culvert  *         *         *
*FRS3          *   5220       *      27*       27*       27*
*FRS3          *   5193       *      12*       12*       12*
*FRS3          *   5181       *      81*       81*       81*
*FRS3          *   5100       *     300*      300*      300*
*FRS3          *   4800       *      52*       52*       52*
*FRS3          *   4748       *       8*        8*        8*
*FRS3          *   4740       *      90*       90*       90*
*FRS3          *   4729.5     *Culvert  *         *         *
*FRS3          *   4650       *      50*       50*       50*
*FRS3          *   4600       *     250*      250*      250*
*FRS3          *   4350       *      72*       72*       72*
*FRS3          *   4278       *      78*       78*       78*
*FRS3          *   4271       *Culvert  *         *         *
*FRS3          *   4200       *      17*       17*       17*
*FRS3          *   4183       *      15*       15*       15*
*FRS3          *   4168       *      68*       68*       68*
*FRS3          *   4100       *     300*      300*      300*
*FRS3          *   3800       *     300*      300*      300*
*FRS3          *   3500       *     300*      300*      300*
*FRS3          *   3200       *     297*      297*      297*
*FRS3          *   2903       *      18*       18*       18*
*FRS3          *   2885       *      85*       85*       85*
*FRS3          *   2800       *     300*      300*      300*
*FRS3          *   2500       *     300*      300*      300*
*FRS3          *   2200       *     300*      300*      300*
*FRS3          *   1900       *     332*      332*      332*
*FRS3          *   1568       *      16*       16*       16*
*FRS3          *   1552       *      52*       52*       52*
*FRS3          *   1500       *     200*      200*      200*
*FRS3          *   1300       *     300*      300*      300*
*FRS3          *   1000       *       0*        0*        0*
*****************************************************************
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SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: Channel

*****************************************************
*     Reach      *   River Sta.   * Contr.  * Expan.  *
*****************************************************
*FRS3           *   31266.2 *       .1*       .3*
*FRS3           *   31216.2 *       .1*       .3*
*FRS3           *   31203.5 *       .1*       .3*
*FRS3           *   31000   *       .1*       .3*
*FRS3           *   30811.5 *       .1*       .3*
*FRS3           *   30801.1 *       .1*       .3*
*FRS3           *   30801   *Culvert  *         *
*FRS3           *   26495   *       .1*       .3*
*FRS3           *   26475   *       .1*       .3*
*FRS3           *   26200   *       .1*       .3*
*FRS3           *   25900   *       .1*       .3*
*FRS3           *   25600   *       .1*       .3*
*FRS3           *   25299   *       .1*       .3*
*FRS3           *   25195   *       .1*       .3*
*FRS3           *   25000   *       .1*       .3*
*FRS3           *   24700   *       .1*       .3*
*FRS3           *   24400   *       .1*       .3*
*FRS3           *   24081   *       .1*       .3*
*FRS3           *   24061   *       .1*       .3*
*FRS3           *   24052.5 *Culvert  *         *
*FRS3           *   23639   *       .1*       .3*
*FRS3           *   23619   *       .1*       .3*
*FRS3           *   23300   *       .1*       .3*
*FRS3           *   23000   *       .1*       .3*
*FRS3           *   22731   *       .1*       .3*
*FRS3           *   22711   *       .1*       .3*
*FRS3           *   22704.4 *Culvert  *         *
*FRS3           *   22635   *       .1*       .3*
*FRS3           *   22615   *       .1*       .3*
*FRS3           *   22500   *       .1*       .3*
*FRS3           *   22200   *       .1*       .3*
*FRS3           *   21900   *       .1*       .3*
*FRS3           *   21600   *       .1*       .3*
*FRS3           *   21326   *       .1*       .3*
*FRS3           *   21307.8 *       .1*       .3*
*FRS3           *   21274.9 *       .1*       .3*
*FRS3           *   21265.8 *Culvert  *         *
*FRS3           *   21136   *       .1*       .3*
*FRS3           *   21135   *       .1*       .3*
*FRS3           *   21124   *       .1*       .3*
*FRS3           *   20850   *       .1*       .3*
*FRS3           *   20580   *       .1*       .3*
*FRS3           *   20550   *       .1*       .3*
*FRS3           *   20538   *       .1*       .3*
*FRS3           *   20532   *       .1*       .3*
*FRS3           *   20502   *       .1*       .3*
*FRS3           *   20501   *       .1*       .3*
*FRS3           *   20486   *       .1*       .3*
*FRS3           *   20300   *       .1*       .3*
*FRS3           *   20077   *       .1*       .3*
*FRS3           *   20048   *       .1*       .3*
*FRS3           *   20036   *       .1*       .3*
*FRS3           *   20030   *       .1*       .3*
*FRS3           *   20000   *       .1*       .3*
*FRS3           *   19999   *       .1*       .3*
*FRS3           *   19984   *       .1*       .3*
*FRS3           *   19650   *       .1*       .3*
*FRS3           *   19310   *       .1*       .3*
*FRS3           *   19277   *       .1*       .3*
*FRS3           *   19267   *       .1*       .3*
*FRS3           *   19260   *       .1*       .3*
*FRS3           *   19251.7 *       .1*       .3*
*FRS3           *   18960   *       .1*       .3*
*FRS3           *   18920   *       .1*       .3*
*FRS3           *   18340   *       .1*       .3*
*FRS3           *   18200   *       .1*       .3*
*FRS3           *   17900   *       .1*       .3*
*FRS3           *   17579   *       .1*       .3*
*FRS3           *   17549   *       .1*       .3*
*FRS3           *   17537   *       .1*       .3*
*FRS3           *   17531   *       .1*       .3*
*FRS3           *   17501   *       .1*       .3*
*FRS3           *   17500   *       .1*       .3*
*FRS3           *   17486   *       .1*       .3*
*FRS3           *   17350   *       .1*       .3*
*FRS3           *   17050   *       .1*       .3*
*FRS3           *   16779   *       .1*       .3*
*FRS3           *   16749   *       .1*       .3*
*FRS3           *   16737   *       .1*       .3*
*FRS3           *   16731   *       .1*       .3*
*FRS3           *   16701   *       .1*       .3*
*FRS3           *   16700   *       .1*       .3*
*FRS3           *   16686   *       .1*       .3*
*FRS3           *   16500   *       .1*       .3*
*FRS3           *   16200   *       .1*       .3*
*FRS3           *   15984   *       .1*       .3*
*FRS3           *   15938.7 *       .1*       .3*
*FRS3           *   15918.7 *       .1*       .3*
*FRS3           *   15918.6 *Culvert  *         *
*FRS3           *   15742.4 *       .1*       .3*
*FRS3           *   15741.4 *       .1*       .3*
*FRS3           *   15731   *       .1*       .3*
*FRS3           *   15591   *       .1*       .3*
*FRS3           *   15561   *       .1*       .3*
*FRS3           *   15537   *       .1*       .3*
*FRS3           *   15531   *       .1*       .3*
*FRS3           *   15501   *       .1*       .3*
*FRS3           *   15500   *       .1*       .3*
*FRS3           *   15485   *       .1*       .3*
*FRS3           *   15300   *       .1*       .3*
*FRS3           *   15081   *       .1*       .3*
*FRS3           *   15046   *       .1*       .3*
*FRS3           *   15042   *       .1*       .3*
*FRS3           *   15000   *       .1*       .3*
*FRS3           *   14600   *       .1*       .3*
*FRS3           *   14300   *       .1*       .3*
*FRS3           *   14255   *       .1*       .3*
*FRS3           *   14238   *       .1*       .3*
*FRS3           *   14225   *       .1*       .3*
*FRS3           *   14223.6 *Culvert  *         *
*FRS3           *   14175   *       .1*       .3*
*FRS3           *   14150   *       .1*       .3*
*FRS3           *   14100   *       .1*       .3*
*FRS3           *   13900   *       .1*       .3*
*FRS3           *   13600   *       .1*       .3*
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*FRS3          *    13296   *       .1*       .3*
*FRS3          *    13266   *       .1*       .3*
*FRS3          *    13248   *       .1*       .3*
*FRS3          *    13235   *       .1*       .3*
*FRS3          *    13233.5 *Culvert  *         *
*FRS3          *    13185   *       .1*       .3*
*FRS3          *    13175   *       .1*       .3*
*FRS3          *    13100   *       .1*       .3*
*FRS3          *    12900   *       .1*       .3*
*FRS3          *    12767   *       .1*       .3*
*FRS3          *    12736   *       .1*       .3*
*FRS3          *    12716   *       .1*       .3*
*FRS3          *    12710   *       .1*       .3*
*FRS3          *    12680   *       .1*       .3*
*FRS3          *    12679   *       .1*       .3*
*FRS3          *    12665   *       .1*       .3*
*FRS3          *    12450   *       .1*       .3*
*FRS3          *    12270   *       .1*       .3*
*FRS3          *    12240   *       .1*       .3*
*FRS3          *    12216   *       .1*       .3*
*FRS3          *    12210   *       .1*       .3*
*FRS3          *    12180   *       .1*       .3*
*FRS3          *    12179   *       .1*       .3*
*FRS3          *    12164   *       .1*       .3*
*FRS3          *    11900   *       .1*       .3*
*FRS3          *    11590   *       .1*       .3*
*FRS3          *    11560   *       .1*       .3*
*FRS3          *    11536   *       .1*       .3*
*FRS3          *    11530   *       .1*       .3*
*FRS3          *    11500   *       .1*       .3*
*FRS3          *    11499   *       .1*       .3*
*FRS3          *    11484   *       .1*       .3*
*FRS3          *    11300   *       .1*       .3*
*FRS3          *    11133   *       .1*       .3*
*FRS3          *    11085.5 *       .1*       .3*
*FRS3          *    11068.7 *       .1*       .3*
*FRS3          *    11062.7 *       .1*       .3*
*FRS3          *    11032.7 *       .1*       .3*
*FRS3          *    11031.7 *       .1*       .3*
*FRS3          *    11017.2 *       .1*       .3*
*FRS3          *    10800   *       .1*       .3*
*FRS3          *    10645   *       .1*       .3*
*FRS3          *    10599.1 *       .1*       .3*
*FRS3          *    10598   *Culvert  *         *
*FRS3          *    10535.1 *       .1*       .3*
*FRS3          *    10510.8 *       .1*       .3*
*FRS3          *    10509.8 *       .1*       .3*
*FRS3          *    10500   *       .1*       .3*
*FRS3          *    10350   *       .1*       .3*
*FRS3          *    10154   *       .1*       .3*
*FRS3          *    10124   *       .1*       .3*
*FRS3          *    10100   *       .1*       .3*
*FRS3          *    10094   *       .1*       .3*
*FRS3          *    10064   *       .1*       .3*
*FRS3          *    10063   *       .1*       .3*
*FRS3          *    10048   *       .1*       .3*
*FRS3          *    9900    *       .1*       .3*
*FRS3          *    9728    *       .1*       .3*
*FRS3          *    9675    *       .1*       .3*
*FRS3          *    9660    *       .1*       .3*
*FRS3          *    9654    *       .1*       .3*
*FRS3          *    9624    *       .1*       .3*
*FRS3          *    9623    *       .1*       .3*
*FRS3          *    9608    *       .1*       .3*
*FRS3          *    9450    *       .1*       .3*
*FRS3          *    9299    *       .1*       .3*
*FRS3          *    9272.1  *       .1*       .3*
*FRS3          *    9272    *Culvert  *         *
*FRS3          *    9218.1  *       .1*       .3*
*FRS3          *    9193.8  *       .1*       .3*
*FRS3          *    9192.8  *       .1*       .3*
*FRS3          *    9183    *       .1*       .3*
*FRS3          *    9000    *       .1*       .3*
*FRS3          *    8863    *       .1*       .3*
*FRS3          *    8809    *       .1*       .3*
*FRS3          *    8785    *       .1*       .3*
*FRS3          *    8779    *       .1*       .3*
*FRS3          *    8749    *       .1*       .3*
*FRS3          *    8748    *       .1*       .3*
*FRS3          *    8733    *       .1*       .3*
*FRS3          *    8600    *       .1*       .3*
*FRS3          *    8437    *       .1*       .3*
*FRS3          *    8400    *       .1*       .3*
*FRS3          *    8376    *       .1*       .3*
*FRS3          *    8370    *       .1*       .3*
*FRS3          *    8340    *       .1*       .3*
*FRS3          *    8339    *       .1*       .3*
*FRS3          *    8325    *       .1*       .3*
*FRS3          *    8150    *       .1*       .3*
*FRS3          *    8004    *       .1*       .3*
*FRS3          *    7970.4  *       .1*       .3*
*FRS3          *    7960.4  *       .1*       .3*
*FRS3          *    7958.2  *Culvert  *         *
*FRS3          *    7907.3  *       .1*       .3*
*FRS3          *    7886    *       .1*       .3*
*FRS3          *    7885    *       .1*       .3*
*FRS3          *    7876    *       .1*       .3*
*FRS3          *    7700    *       .1*       .3*
*FRS3          *    7425    *       .1*       .3*
*FRS3          *    7376    *       .1*       .3*
*FRS3          *    7358    *       .1*       .3*
*FRS3          *    7352    *       .1*       .3*
*FRS3          *    7322    *       .1*       .3*
*FRS3          *    7321    *       .1*       .3*
*FRS3          *    7306    *       .1*       .3*
*FRS3          *    7150    *       .1*       .3*
*FRS3          *    7030    *       .1*       .3*
*FRS3          *    7000    *       .1*       .3*
*FRS3          *    6982    *       .1*       .3*
*FRS3          *    6976    *       .1*       .3*
*FRS3          *    6946    *       .1*       .3*
*FRS3          *    6945    *       .1*       .3*
*FRS3          *    6930    *       .1*       .3*
*FRS3          *    6800    *       .1*       .3*
*FRS3          *    6700    *       .1*       .3*
*FRS3          *    6673.16 *       .1*       .3*
*FRS3          *    6663.16 *       .1*       .3*
*FRS3          *    6661.6  *Culvert  *         *
*FRS3          *    6570    *       .1*       .3*
*FRS3          *    6550    *       .1*       .3*
*FRS3          *    6200    *       .1*       .3*
*FRS3          *    5920    *       .1*       .3*
*FRS3          *    5902    *       .1*       .3*
*FRS3          *    5600    *       .1*       .3*
*FRS3          *    5400    *       .1*       .3*
*FRS3          *    5342.1  *Culvert  *         *
*FRS3          *    5220    *       .1*       .3*
*FRS3          *    5193    *       .1*       .3*
*FRS3          *    5181    *       .1*       .3*
*FRS3          *    5100    *       .1*       .3*
*FRS3          *    4800    *       .1*       .3*
*FRS3          *    4748    *       .1*       .3*
*FRS3          *    4740    *       .1*       .3*
*FRS3          *    4729.5  *Culvert  *         *
*FRS3          *    4650    *       .1*       .3*
*FRS3          *    4600    *       .1*       .3*
*FRS3          *    4350    *       .1*       .3*
*FRS3          *    4278    *       .1*       .3*
*FRS3          *    4271    *Culvert  *         *
*FRS3          *    4200    *       .1*       .3*
*FRS3          *    4183    *       .1*       .3*
*FRS3          *    4168    *       .1*       .3*
*FRS3          *    4100    *       .1*       .3*
*FRS3          *    3800    *       .1*       .3*
*FRS3          *    3500    *       .1*       .3*
*FRS3          *    3200    *       .1*       .3*
*FRS3          *    2903    *       .1*       .3*
*FRS3          *    2885    *       .1*       .3*
*FRS3          *    2800    *       .1*       .3*
*FRS3          *    2500    *       .1*       .3*
*FRS3          *    2200    *       .1*       .3*
*FRS3          *    1900    *       .1*       .3*
*FRS3          *    1568    *       .1*       .3*
*FRS3          *    1552    *       .1*       .3*
*FRS3          *    1500    *       .1*       .3*
*FRS3          *    1300    *       .1*       .3*
*FRS3          *    1000    *       .1*       .3*
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B.3 HEC-RAS MODEL - SUBCRITICAL FLOW ANALYSIS WITH N=0.045

Note: Required freeboard y=0.25(h+V2/2g), and 1-foot minimum for subcritical flow and 2-foot minimum for supercritical flow.

Bank elevations are generally referred to the designed channel top. At some locations where the designed channel top does not provide enough freeboard, the highest ground elevation above channel top will be selected as the bank elevation and check the freeboard.

River Sta	Jackrabbit Trail Sta	Design Q (cfs)	Low Flow Elev (ft)	W.S. Elev (ft)	Bank Elevation (ft)	Flow Depth (ft)	Velocity (fps)	Froude Number	Required Free-board (ft)	Provided Free-board (ft)	Enough Free-board	Note
6200	10902	700	1082.12	1084.59	1088.12	2.47	7.94	1.00	2.00	3.53	YES	Concrete Channel
6550	11252	700	1083.13	1085.61	1089.13	2.48	6.88	0.81	1.00	3.52	YES	
6570	11272	700	1083.15	1086.57	1089.15	3.42	10.42	1.00	2.00	2.58	YES	
Culvert (Palm Ln)												
6663.2	11365	700	1083.60	1088.75	1091.60	5.15	8.46	0.66	1.57	2.85	YES	Concrete Drop Inlet
6673.2	11376	700	1084.60	1088.49	1092.60	3.89	11.23	1.01	2.00	4.11	YES	
6700	11402	700	1084.63	1090.59	1092.63	5.96	2.37	0.21	1.51	2.04	YES	
6800	11502	700	1084.73	1090.67	1092.73	5.94	2.61	0.24	1.51	2.06	YES	
6930	11632	700	1084.86	1090.82	1092.86	5.96	2.69	0.25	1.52	2.04	YES	Riprap
6945	11647	700	1084.87	1090.80	1092.87	5.93	3.26	0.25	1.52	2.07	YES	
6946	11648	700	1084.87	1090.84	1092.87	5.97	2.89	0.21	1.52	2.03	YES	Concrete Drop Structure
6976	11678	700	1084.90	1090.40	1092.90	5.50	7.04	0.53	1.57	2.50	YES	
6982	11684	700	1084.90	1090.26	1092.90	5.36	7.98	0.64	1.59	2.64	YES	
7000	11702	700	1087.90	1092.00	1095.90	4.10	10.76	1.00	2.00	3.90	YES	
7030	11732	700	1087.93	1093.92	1095.93	5.99	2.63	0.24	1.52	2.01	YES	Riprap
7150	11852	700	1088.05	1094.06	1096.05	6.01	2.63	0.24	1.53	1.99	YES	
7306	12008	700	1088.21	1094.23	1096.21	6.02	2.65	0.24	1.53	1.98	YES	Riprap
7321	12023	700	1088.22	1094.21	1096.22	5.99	3.23	0.25	1.54	2.01	YES	
7322	12024	700	1088.22	1094.25	1096.22	6.03	2.86	0.21	1.54	1.97	YES	Concrete Drop Structure
7352	12054	700	1088.25	1093.82	1096.25	5.57	6.95	0.52	1.58	2.43	YES	
7358	12060	700	1088.25	1093.68	1096.25	5.43	7.85	0.62	1.60	2.57	YES	
7376	12078	700	1091.25	1095.36	1099.25	4.11	10.75	1.00	2.00	3.89	YES	
7425	12127	700	1091.30	1097.30	1099.30	6.00	2.68	0.24	1.53	2.00	YES	Riprap
7700	12402	700	1091.58	1097.62	1099.58	6.04	2.65	0.24	1.54	1.96	YES	
7876	12578	700	1091.76	1097.82	1099.76	6.06	2.42	0.22	1.54	1.94	YES	
7885	12587	700	1091.76	1097.82	1099.76	6.06	2.53	0.19	1.54	1.94	YES	Riprap
7886	12588	700	1091.76	1097.85	1099.76	6.09	2.22	0.16	1.54	1.91	YES	Concrete Apron
7907	12609	700	1091.88	1097.17	1099.88	5.29	8.24	0.63	1.59	2.71	YES	
Culvert (Encanto Ave)												
7960	12662	700	1093.14	1098.29	1101.50	5.15	8.47	0.66	1.57	3.21	YES	Concrete Drop Inlet
7970	12672	700	1094.03	1097.92	1102.03	3.89	11.22	1.00	2.00	4.11	YES	
8004	12706	700	1094.05	1100.01	1102.05	5.96	2.61	0.24	1.52	2.04	YES	Riprap
8150	12852	700	1094.19	1100.18	1102.19	5.99	2.69	0.25	1.53	2.01	YES	
8325	13027	700	1094.37	1100.39	1102.37	6.02	2.67	0.24	1.53	1.98	YES	Riprap
8339	13041	700	1094.38	1100.36	1102.38	5.98	3.23	0.25	1.54	2.02	YES	
8340	13042	700	1094.38	1100.40	1102.38	6.02	2.86	0.21	1.54	1.98	YES	Concrete Drop
8370	13072	700	1094.41	1099.97	1102.41	5.56	6.96	0.52	1.58	2.44	YES	
8376	13078	700	1094.41	1099.83	1102.41	5.42	7.87	0.63	1.60	2.58	YES	Structure
8400	13102	700	1098.41	1102.51	1106.41	4.10	10.76	1.00	2.00	3.90	YES	
8437	13139	700	1098.45	1104.44	1106.45	5.99	2.68	0.25	1.53	2.01	YES	Riprap
8600	13302	700	1098.61	1104.64	1106.61	6.03	2.49	0.23	1.53	1.97	YES	
8733	13435	700	1098.75	1104.77	1106.75	6.02	2.65	0.24	1.53	1.98	YES	Riprap
8748	13450	700	1098.76	1104.75	1106.76	5.99	3.23	0.25	1.54	2.01	YES	
8749	13451	700	1098.76	1104.79	1106.76	6.03	2.86	0.21	1.54	1.97	YES	Concrete Drop Structure
8779	13481	700	1098.79	1104.36	1106.79	5.57	6.95	0.52	1.58	2.43	YES	
8785	13487	700	1098.79	1104.22	1106.79	5.43	7.85	0.62	1.60	2.57	YES	
8809	13511	700	1102.79	1106.90	1110.79	4.11	10.75	1.00	2.00	3.89	YES	
8863	13565	700	1102.84	1108.84	1110.84	6.00	2.72	0.24	1.53	2.00	YES	Riprap
9000	13702	700	1102.98	1109.01	1110.98	6.03	2.66	0.24	1.53	1.97	YES	
9183	13885	700	1103.17	1109.22	1111.17	6.05	2.52	0.23	1.54	1.95	YES	Riprap
9192.8	13894	700	1103.23	1109.23	1111.23	6.00	2.56	0.20	1.53	2.00	YES	Concrete Apron
9193.8	13895	700	1103.23	1109.25	1111.23	6.02	2.25	0.16	1.52	1.98	YES	
9218.1	13920	700	1103.23	1108.60	1111.23	5.37	8.12	0.62	1.60	2.63	YES	
Culvert (Virginia Ave)												
9272.1	13974	700	1106.97	1112.11	1114.99	5.14	8.47	0.66	1.56	2.88	YES	Riprap
9299	14001	700	1106.99	1113.29	1114.99	6.30	2.18	0.19	1.59	1.70	YES	
9450	14152	700	1107.12	1113.40	1115.12	6.28	2.47	0.22	1.59	1.72	YES	
9608	14310	700	1107.27	1113.54	1115.27	6.27	2.50	0.22	1.59	1.73	YES	
9623	14317	700	1107.35	1113.52	1115.35	6.17	3.12	0.24	1.58	1.83	YES	Riprap
9624	14325	700	1107.35	1113.55	1115.35	6.20	2.78	0.20	1.58	1.80	YES	
9654	14356	700	1107.35	1113.16	1115.35	5.81	6.66	0.49	1.62	2.19	YES	Concrete Drop Structure
9660	14362	700	1107.35	1113.05	1115.35	5.70	7.45	0.58	1.64	2.30	YES	
9675	14377	700	1109.85	1113.95	1117.85	4.10	10.76	1.00	2.00	3.90	YES	
9728	14430	700	1109.87	1115.90	1117.87	6.03	2.74	0.25	1.54	1.97	YES	Riprap
9900	14602	700	1110.04	1116.12	1118.04	6.08	2.47	0.23	1.54	1.92	YES	
10048	14750	700	1110.19	1116.27	1118.19	6.08	2.57	0.23	1.55	1.92	YES	Riprap
10063	14765	700	1110.20	1116.24	1118.20	6.04	3.20	0.24	1.55	1.96	YES	
10064	14766	700	1110.20	1116.28	1118.20	6.08	2.84	0.20	1.55	1.92	YES	Concrete Drop Structure
10094	14796	700	1110.23	1115.86	1118.23	5.63	6.88	0.51	1.59	2.37	YES	
10100	14802	700	1110.23	1115.73	1118.23	5.50	7.75	0.61	1.61	2.50	YES	
10124	14826	700	1114.23	1118.34	1122.23	4.11	10.75	1.00	2.00	3.89	YES	
10154	14856	700	1114.26	1120.25	1122.26	5.99	2.64	0.24	1.52	2.01	YES	Riprap
10350	15052	700	1114.46	1120.48	1122.46	6.02	2.59	0.24	1.53	1.98	YES	
10500	15202	700	1114.61	1120.64	1122.61	6.03	2.54	0.23	1.53	1.97	YES	
10510	15211	700	1114.63	1120.65	1122.63	6.02	2.55	0.20	1.53	1.98	YES	Riprap
10511	15212	700	1114.71	1120.67	1122.71	5.96	2.27	0.16	1.51	2.04	YES	Concrete Apron
10535	15237	700	1114.71	1120.00	1122.71	5.29	8.24	0.63	1.59	2.71	YES	
Culvert (Thomas Rd)												
10599	15301	700	1118.17	1123.31	1126.20	5.14	8.47	0.66	1.56	2.89	YES	Riprap
10645	15347	700	1118.20	1124.51	1126.20	6.31	2.09	0.18	1.59	1.69	YES	
10800	15502	700	1118.35	1124.61	1126.35	6.26	2.38	0.22	1.59	1.74	YES	
11017	15719	700	1118.56	1124.81	1126.56	6.25	2.49	0.22	1.59	1.75	YES	Riprap
11032	15733	700	1118.59	1124.78	1126.59	6.19	3.11	0.23	1.59	1.81	YES	
11033	15734	700	1118.59	1124.82	1126.59	6.23	2.77	0.20	1.59	1.77	YES	Concrete Drop
11063	15764	700	1118.61	1124.43	1126.61	5.82	6.65	0.49	1.63	2.18	YES	

11069	15770	700	1118.61	1124.31	1126.61	5.70	7.44	0.58	1.64	2.30	YES	Structure
11086	15787	700	1121.41	1125.51	1129.41	4.10	10.76	1.00	2.00	3.90	YES	
11133	15835	700	1121.45	1127.45	1129.45	6.00	2.81	0.25	1.53	2.00	YES	Riprap
11300	16002	700	1121.62	1127.66	1129.62	6.04	2.65	0.24	1.54	1.96	YES	
11484	16186	700	1121.80	1127.88	1129.80	6.08	2.63	0.24	1.55	1.92	YES	Riprap
11499	16201	700	1121.81	1127.85	1129.81	6.04	3.19	0.24	1.55	1.96	YES	
11500	16202	700	1121.81	1127.89	1129.81	6.08	2.84	0.20	1.55	1.92	YES	Concrete Drop Structure
11530	16232	700	1121.85	1127.47	1129.85	5.62	6.89	0.51	1.59	2.38	YES	
11536	16238	700	1121.85	1127.34	1129.85	5.49	7.77	0.61	1.61	2.51	YES	
11560	16262	700	1125.85	1129.96	1133.85	4.11	10.75	1.00	2.00	3.89	YES	
11590	16292	700	1125.88	1131.86	1133.88	5.98	2.69	0.25	1.52	2.02	YES	Riprap
11900	16602	700	1126.19	1132.23	1134.19	6.04	2.42	0.22	1.53	1.96	YES	
12164	16866	700	1126.45	1132.50	1134.45	6.05	2.65	0.24	1.54	1.95	YES	Riprap
12179	16881	700	1126.46	1132.47	1134.46	6.01	3.21	0.25	1.54	1.99	YES	
12180	16882	700	1126.46	1132.51	1134.46	6.05	2.85	0.20	1.54	1.95	YES	Concrete Drop Structure
12210	16912	700	1126.50	1132.09	1134.50	5.59	6.93	0.52	1.58	2.41	YES	
12216	16918	700	1126.50	1131.95	1134.50	5.45	7.82	0.62	1.60	2.55	YES	
12240	16942	700	1130.50	1134.61	1138.50	4.11	10.75	1.00	2.00	3.89	YES	
12270	16972	700	1130.53	1136.51	1138.53	5.98	2.69	0.25	1.52	2.02	YES	Riprap
12450	17152	700	1130.71	1136.73	1138.71	6.02	2.50	0.23	1.53	1.98	YES	
12665	17367	700	1130.92	1136.96	1138.92	6.04	2.65	0.24	1.54	1.96	YES	Riprap
12679	17381	700	1130.93	1136.94	1138.93	6.01	3.21	0.25	1.54	1.99	YES	
12680	17382	700	1130.93	1136.98	1138.93	6.05	2.85	0.20	1.54	1.95	YES	Concrete Drop Structure
12710	17412	700	1130.97	1136.67	1138.97	5.70	6.12	0.45	1.57	2.30	YES	
12716	17418	700	1130.97	1136.57	1138.97	5.60	6.84	0.53	1.58	2.40	YES	
12736	17438	700	1134.29	1138.15	1142.29	3.86	10.39	1.00	2.00	4.14	YES	
12767	17469	700	1134.34	1139.92	1141.34	5.58	2.78	0.25	1.43	1.42	NO	Riprap
12900	17602	700	1134.46	1140.11	1141.46	5.65	2.27	0.21	1.43	1.35	NO	
13100	17802	700	1134.76	1140.28	1141.76	5.52	2.39	0.22	1.40	1.48	YES	
13175	17877	700	1134.89	1140.28	1141.89	5.39	4.13	0.34	1.41	1.61	YES	
13185	17887	700	1135.99	1140.28	1142.99	4.29	4.45	0.38	1.15	2.71	YES	
Culvert (Osborn Rd)												
13235	17937	700	1135.87	1140.49	1142.87	4.62	4.07	0.34	1.22	2.38	YES	
13248	17950	700	1136.01	1140.52	1143.01	4.51	4.19	0.35	1.20	2.49	YES	
13266	17968	700	1139.67	1142.00	1146.67	2.33	8.44	1.01	2.00	4.67	YES	
13296	17998	700	1139.96	1143.22	1146.96	3.26	3.81	0.43	1.00	3.74	YES	
13600	18302	700	1140.28	1144.10	1147.28	3.82	2.83	0.28	1.00	3.18	YES	
13900	18602	700	1140.60	1144.60	1147.60	4.00	2.86	0.29	1.03	3.00	YES	
14100	18802	700	1140.80	1144.96	1147.80	4.16	3.00	0.31	1.07	2.84	YES	
14150	18852	700	1140.86	1144.96	1147.86	4.10	4.75	0.45	1.11	2.90	YES	
14175	18877	700	1141.28	1145.07	1148.28	3.79	4.76	0.45	1.04	3.21	YES	
Culvert (Clarendon Ave)												
14225	18927	700	1141.43	1145.43	1148.43	4.00	4.57	0.40	1.08	3.00	YES	
14238	18940	700	1141.44	1145.48	1148.44	4.04	4.61	0.41	1.09	2.96	YES	
14255	18957	700	1144.86	1147.19	1151.86	2.33	8.42	1.01	2.00	4.67	YES	
14300	19002	700	1145.30	1148.55	1152.30	3.25	4.14	0.48	1.00	3.75	YES	
14600	19302	700	1145.55	1149.51	1152.55	3.96	2.80	0.28	1.02	3.04	YES	
15000	19702	700	1145.98	1150.15	1152.98	4.17	2.78	0.28	1.07	2.83	YES	

15042	19744	700	1146.00	1149.35	1154.00	3.35	10.42	1.00	2.00	4.65	YES	
15046	19748	700	1146.41	1149.76	1154.41	3.35	10.42	1.00	2.00	4.65	YES	
15081	19783	700	1146.44	1151.54	1154.44	5.10	3.01	0.29	1.31	2.90	YES	
15300	20002	700	1146.66	1151.90	1154.66	5.24	2.89	0.27	1.34	2.76	YES	
15485	20187	700	1146.85	1152.17	1154.85	5.32	2.82	0.26	1.36	2.68	YES	Riprap
15500	20202	700	1146.85	1152.13	1154.85	5.28	3.73	0.31	1.37	2.72	YES	
15501	20203	700	1146.85	1152.19	1154.85	5.34	3.23	0.25	1.38	2.66	YES	Concrete Drop Structure
15531	20233	700	1146.89	1151.57	1154.89	4.68	8.28	0.68	1.44	3.32	YES	
15537	20239	700	1146.89	1151.20	1154.89	4.31	10.17	0.92	1.48	3.69	YES	
15561	20263	700	1150.89	1155.00	1158.89	4.11	10.75	1.00	2.00	3.89	YES	
15591	20293	700	1150.92	1156.93	1158.92	6.01	2.27	0.20	1.52	1.99	YES	Riprap
15731	20433	700	1151.06	1157.04	1159.06	5.98	2.24	0.20	1.51	2.02	YES	Riprap
15741	20443	700	1151.06	1157.03	1159.06	5.97	2.58	0.20	1.52	2.03	YES	Concrete Apron
15742	20444	700	1151.09	1157.05	1159.09	5.96	2.27	0.16	1.51	2.04	YES	
Culvert (Indian School Rd)												
15919	20620	700	1151.88	1157.28	1161.49	5.40	8.07	0.61	1.60	4.21	YES	Concrete Drop Inlet
15939	20640	700	1153.48	1157.37	1161.48	3.89	11.22	1.00	2.00	4.11	YES	
15984	20686	700	1153.52	1159.50	1161.52	5.98	2.30	0.21	1.52	2.02	YES	Riprap
16200	20902	800	1153.73	1159.68	1161.73	5.95	2.35	0.22	1.51	2.05	YES	
16500	21202	800	1154.03	1159.96	1162.03	5.93	2.61	0.23	1.51	2.07	YES	
16686	21388	800	1154.21	1160.16	1162.21	5.95	2.64	0.24	1.51	2.05	YES	Riprap
16700	21402	800	1154.22	1160.10	1162.22	5.88	3.77	0.29	1.53	2.12	YES	
16701	21403	800	1154.22	1160.16	1162.22	5.94	3.32	0.24	1.53	2.06	YES	Concrete Drop Structure
16731	21433	800	1154.26	1159.70	1162.26	5.44	7.32	0.55	1.57	2.56	YES	
16737	21439	800	1154.26	1159.54	1162.26	5.28	8.34	0.67	1.59	2.72	YES	
16749	21451	800	1156.26	1160.42	1164.26	4.16	10.91	1.01	2.00	3.84	YES	
16779	21481	800	1156.29	1162.39	1164.29	6.10	2.45	0.22	1.55	1.90	YES	Riprap
17050	21752	800	1156.56	1162.64	1164.56	6.08	2.52	0.22	1.54	1.92	YES	
17350	22052	800	1156.86	1162.93	1164.86	6.07	2.52	0.22	1.54	1.93	YES	
17486	22188	800	1156.99	1163.06	1164.99	6.07	2.56	0.23	1.54	1.93	YES	Riprap
17500	22202	800	1157.00	1163.00	1165.00	6.00	3.68	0.28	1.55	2.00	YES	
17501	22203	800	1157.00	1163.05	1165.00	6.05	3.26	0.23	1.55	1.95	YES	Concrete Drop Structure
17531	22233	800	1157.04	1162.63	1165.04	5.59	7.13	0.53	1.59	2.41	YES	
17537	22239	800	1157.04	1162.48	1165.04	5.44	8.07	0.64	1.61	2.56	YES	
17549	22251	800	1159.04	1163.20	1167.04	4.16	10.91	1.01	2.00	3.84	YES	
17579	22281	800	1159.07	1165.17	1167.07	6.10	2.52	0.22	1.55	1.90	YES	Riprap
17900	22602	800	1159.39	1165.48	1167.39	6.09	2.51	0.22	1.55	1.91	YES	
18200	22902	800	1159.69	1165.77	1167.69	6.08	2.51	0.22	1.54	1.92	YES	
18340	23033	800	1159.88	1164.96	1167.88	5.08	9.80	0.77	1.64	2.92	YES	Broken-Back Culvert
18920	23609	800	1161.06	1165.85	1169.06	4.79	10.41	0.84	1.62	3.21	YES	
18960	23640	800	1164.35	1168.63	1173.60	4.28	11.65	0.99	1.60	4.97	YES	
19252	23893	800	1165.42	1169.70	1173.42	4.28	11.65	0.99	1.60	3.72	YES	
19260	23900	800	1165.45	1171.60	1173.45	6.15	4.99	0.36	1.63	1.85	YES	
19267	23906	800	1165.45	1171.60	1173.45	6.15	4.99	0.36	1.63	1.85	YES	Concrete Drop Inlet
19277	23916	800	1166.45	1171.47	1174.45	5.02	6.12	0.48	1.40	2.98	YES	
19310	23940	800	1166.41	1171.99	1174.41	5.58	2.93	0.27	1.43	2.42	YES	Riprap
19650	24280	800	1166.73	1172.45	1174.73	5.72	2.50	0.23	1.45	2.28	YES	

19984	24614	800	1167.06	1172.81	1175.06	5.75	2.78	0.25	1.47	2.25	YES	Riprap
19999	24629	800	1167.07	1172.75	1175.07	5.68	3.92	0.31	1.48	2.32	YES	
20000	24630	800	1167.07	1172.81	1175.07	5.74	3.43	0.25	1.48	2.26	YES	Concrete Drop Structure
20030	24660	800	1167.11	1172.31	1175.11	5.20	7.66	0.59	1.53	2.80	YES	
20036	24666	800	1167.11	1172.11	1175.11	5.00	8.87	0.74	1.56	3.00	YES	
20048	24678	800	1169.11	1173.27	1177.11	4.16	10.90	1.01	2.00	3.84	YES	
20077	24707	800	1169.13	1175.24	1177.13	6.11	2.45	0.22	1.55	1.89	YES	Riprap
20300	24930	800	1169.36	1175.45	1177.36	6.09	2.29	0.21	1.54	1.91	YES	
20486	25116	800	1169.54	1175.61	1177.54	6.07	2.45	0.22	1.54	1.93	YES	Riprap
20501	25131	800	1169.55	1175.55	1177.55	6.00	3.68	0.28	1.55	2.00	YES	
20502	25132	800	1169.55	1175.60	1177.55	6.05	3.26	0.23	1.55	1.95	YES	Concrete Drop Structure
20532	25162	800	1169.59	1175.17	1177.59	5.58	7.15	0.53	1.59	2.42	YES	
20538	25168	800	1169.59	1175.02	1177.59	5.43	8.09	0.64	1.61	2.57	YES	
20550	25180	800	1171.59	1175.75	1179.59	4.16	10.90	1.01	2.00	3.84	YES	
20580	25210	800	1171.62	1177.72	1179.62	6.10	2.49	0.22	1.55	1.90	YES	Riprap
20850	25480	800	1171.89	1177.97	1179.89	6.08	2.32	0.21	1.54	1.92	YES	
21124	25754	800	1172.16	1178.21	1180.16	6.05	2.44	0.22	1.54	1.95	YES	Riprap
21135	25765	700	1172.19	1178.22	1180.19	6.03	2.55	0.20	1.53	1.97	YES	Concrete Apron
21136	25766	700	1172.50	1178.23	1180.50	5.73	2.36	0.17	1.45	2.27	YES	
Culvert (Camelback Rd)												
21275	25896	700	1173.05	1178.49	1183.91	5.44	8.00	0.61	1.61	5.42	YES	Concrete Drop Inlet
21308	25929	700	1175.91	1179.80	1183.91	3.89	11.23	1.01	2.00	4.11	YES	
21326	25956	700	1175.93	1181.86	1183.93	5.93	2.74	0.25	1.51	2.07	YES	Riprap
21600	26230	700	1176.13	1182.19	1184.13	6.06	2.64	0.24	1.54	1.94	YES	
21900	26530	700	1176.34	1182.52	1184.34	6.18	2.55	0.23	1.57	1.82	YES	
22200	26830	700	1176.55	1182.83	1184.55	6.28	2.49	0.22	1.59	1.72	YES	
22500	27130	700	1176.76	1183.11	1184.76	6.35	2.34	0.21	1.61	1.65	YES	
22615	27245	700	1176.84	1183.22	1184.84	6.38	2.32	0.21	1.62	1.62	YES	Riprap
22635	27265	700	1176.86	1183.11	1184.86	6.25	4.14	0.31	1.63	1.75	YES	
Culvert (Colter St)												
22711	27341	700	1177.68	1183.87	1188.90	6.19	4.18	0.31	1.62	5.03	YES	Riprap
22731	27361	700	1177.69	1184.10	1185.69	6.41	2.30	0.21	1.62	1.59	NO	
23000	27630	700	1177.88	1184.33	1185.88	6.45	2.39	0.21	1.63	1.55	NO	
23300	27930	700	1178.09	1184.58	1186.09	6.49	2.25	0.20	1.64	1.51	NO	
23619	28249	700	1178.31	1184.83	1186.31	6.52	2.35	0.21	1.65	1.48	NO	Riprap
23639	28269	700	1178.33	1184.73	1186.33	6.40	4.04	0.30	1.66	1.60	NO	
Culvert (Jackrabbit TR 2)												
24061	28590	700	1179.14	1185.51	1188.30	6.37	4.16	0.31	1.66	2.79	YES	Riprap
24081	28909	700	1179.16	1185.74	1187.16	6.58	2.16	0.19	1.66	1.42	NO	
24400	29209	500	1179.48	1185.95	1187.48	6.47	1.47	0.13	1.63	1.53	NO	
24700	29509	500	1179.78	1186.06	1187.78	6.28	1.64	0.15	1.58	1.72	YES	
25000	29704	500	1180.08	1186.19	1188.08	6.11	1.55	0.15	1.54	1.89	YES	
25195	29724	300	1180.28	1186.27	1188.28	5.99	1.13	0.10	1.50	2.01	YES	
25299	29808	300	1180.43	1186.30	1188.43	5.87	1.16	0.11	1.47	2.13	YES	
25600	30109	300	1180.73	1186.37	1188.73	5.64	1.27	0.12	1.42	2.36	YES	
25900	30409	300	1181.03	1186.46	1189.03	5.43	1.35	0.13	1.36	2.57	YES	
26200	30709	300	1181.33	1186.57	1189.33	5.24	1.42	0.14	1.32	2.76	YES	
26475	30984	300	1181.61	1186.68	1189.61	5.07	1.52	0.15	1.28	2.93	YES	Riprap
26495	31004	300	1181.63	1186.66	1189.63	5.03	2.27	0.19	1.28	2.97	YES	
Culvert (CIPP+HDPE)												
30801	35311	285	1187.13	1192.74	1195.13	5.61	2.94	0.22	1.44	2.39	YES	Riprap
30812	35321	285	1187.14	1192.85	1195.14	5.71	1.47	0.11	1.44	2.29	YES	
31000	35510	285	1187.33	1192.89	1194.33	5.56	0.24	0.02	1.39	1.44	YES	
31204	35713	285	1187.54	1192.88	1194.54	5.34	1.32	0.11	1.34	1.66	YES	
31216	35726	285	1187.55	1192.85	1194.55	5.30	2.26	0.17	1.34	1.70	YES	
31266	35776	285	1187.60	1192.78	1194.60	5.18	3.65	0.28	1.35	1.82	YES	

```
                    HEC-RAS Version 4.1.0 Jan 2010
                     U.S. Army Corps of Engineers
                    Hydrologic Engineering Center
                          609 Second Street
                          Davis, California


          X     X  XXXXXX    XXXX        XXXX       XX      XXXX
          X     X  X        X    X       X   X     X  X    X
          X     X  X        X            X   X    X    X   X
          XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
          X     X  X        X            X  X     X    X        X
          X     X  X        X    X       X   X    X    X        X
          X     X  XXXXXX    XXXX        X    X   X    X   XXXXX


*****************************************************************************

PROJECT DATA
Project Title: FRS3 Outlet Channel
Project File : WTO3SUB2.prj
Run Date and Time: 2/3/2011 6:01:57 PM

Project in English units

Project Description:
Project: White Tanks FRS #3 Outlet Channel Final Design

Prepared by:
Hoskin
Ryan Consultants

Prepared for:
Flood Control District of Maricopa
County

Storm Event: 100-Year
Manning's n for earthen channel were set at
0.045, assuming poor maitenance and overgrowing vegetation.
Discharges were
obtained from the HEC-1 model prepared for this project.

River station is
along the alignment of channel.  Jackrabbit Trail station is also provided for
cross-sections in the description.

River station is along the channel
alignment.  Jackrabbit Trail station is also provided for cross-sections in the
description.


*****************************************************************************

PLAN DATA

Plan Title: Subcritical Flow Calc
Plan File : G:\Projects\09\09-077 WTO3 Final\08 - 100% Design B\Hydro\HEC-RAS\WTO3SUB2.p01

          Geometry Title: Final Design
          Geometry File : G:\Projects\09\09-077 WTO3 Final\08 - 100% Design B\Hydro\HEC-RAS\WTO3SUB2.g01

          Flow Title    : 100-year design flow
          Flow File     : G:\Projects\09\09-077 WTO3 Final\08 - 100% Design B\Hydro\HEC-RAS\WTO3SUB2.f01

Plan Description:
Subcritical flow with Manning's n=0.045


Plan Summary Information:
Number of:  Cross Sections =  258    Multiple Openings  =    0
            Culverts       =   14    Inline Structures  =    0
            Bridges        =    0    Lateral Structures =    0

Computational Information
    Water surface calculation tolerance  =  0.01
    Critical depth calculation tolerance =  0.01
    Maximum number of iterations         =  20
    Maximum difference tolerance         =  0.3
    Flow tolerance factor                =  0.001

Computation Options
    Critical depth computed only where necessary
    Conveyance Calculation Method: At breaks in n values only
    Friction Slope Method:         Average Conveyance
    Computational Flow Regime:     Subcritical Flow


*****************************************************************************

FLOW DATA

Flow Title: 100-year design flow
Flow File : G:\Projects\09\09-077 WTO3 Final\08 - 100% Design B\Hydro\HEC-RAS\WTO3SUB2.f01

Flow Data (cfs)
*************************************************************
* River          Reach          RS       *          N=0.045 *
* Channel        FRS3           31266.2  *              285 *
* Channel        FRS3           26495    *              300 *
* Channel        FRS3           25000    *              500 *
* Channel        FRS3           24081    *              700 *
* Channel        FRS3           21124    *              800 *
* Channel        FRS3           15984    *              700 *
* Channel        FRS3           5400     *             1328 *
* Channel        FRS3           4748     *             1549 *
*************************************************************

Boundary Conditions
*****************************************************************************************************
* River          Reach          Profile          *          Upstream                  Downstream    *
*****************************************************************************************************
* Channel        FRS3           N=0.045          *        Normal S = 0.001        Known WS = 1052.1 *
*****************************************************************************************************
Inline Structure Gate Openings
River = Channel
Reach = FRS3              RS = 30790
Gate  = Slide Gate
  # Open Open Ht
****************
       5       2

*****************************************************************************

SUMMARY OF MANNING'S N VALUES

River:Channel
*******************************************************************
*     Reach      *   River Sta.   *   n1    *   n2    *   n3    *
*******************************************************************
*FRS3            *   31266.2      *    .045*    .015*    .045*
*FRS3            *   31216.2      *    .045*    .035*    .045*
*FRS3            *   31203.5      *    .045*    .045*    .045*
*FRS3            *   31000        *    .045*    .045*    .045*
*FRS3            *   30811.5      *    .045*    .045*    .045*
*FRS3            *   30801.1      *    .045*    .035*    .045*
*FRS3            *   30801        *Culvert  *       *       *
*FRS3            *   26495        *    .045*    .045*    .045*
*FRS3            *   26475        *    .045*    .045*    .045*
*FRS3            *   26200        *    .045*    .045*    .045*
*FRS3            *   25900        *    .045*    .045*    .045*
*FRS3            *   25600        *    .045*    .045*    .045*
```

*FRS3	*	25299	*	.045*	.045*	.045*
*FRS3	*	25195	*	.045*	.045*	.045*
*FRS3	*	25000	*	.045*	.045*	.045*
*FRS3	*	24700	*	.045*	.045*	.045*
*FRS3	*	24400	*	.045*	.045*	.045*
*FRS3	*	24081	*	.045*	.045*	.045*
*FRS3	*	24061	*	.045*	.035*	.045*
*FRS3	*	24052.5	*Culvert	*	*	*
*FRS3	*	23639	*	.045*	.035*	.045*
*FRS3	*	23619	*	.045*	.045*	.045*
*FRS3	*	23300	*	.045*	.045*	.045*
*FRS3	*	23000	*	.045*	.045*	.045*
*FRS3	*	22731	*	.045*	.045*	.045*
*FRS3	*	22711	*	.045*	.035*	.045*
*FRS3	*	22704.4	*Culvert	*	*	*
*FRS3	*	22635	*	.045*	.035*	.045*
*FRS3	*	22615	*	.045*	.045*	.045*
*FRS3	*	22500	*	.045*	.045*	.045*
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*FRS3	*	21600	*	.045*	.045*	.045*
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*FRS3	*	21307.8	*	.045*	.015*	.045*
*FRS3	*	21274.9	*	.045*	.015*	.045*
*FRS3	*	21265.8	*Culvert	*	*	*
*FRS3	*	21136	*	.045*	.015*	.045*
*FRS3	*	21135	*	.045*	.035*	.045*
*FRS3	*	21124	*	.045*	.045*	.045*
*FRS3	*	20850	*	.045*	.045*	.045*
*FRS3	*	20580	*	.045*	.045*	.045*
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*FRS3	*	20538	*	.045*	.015*	.045*
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*FRS3	*	20502	*	.045*	.015*	.045*
*FRS3	*	20501	*	.045*	.035*	.045*
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*FRS3	*	20300	*	.045*	.045*	.045*
*FRS3	*	20077	*	.045*	.045*	.045*
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*FRS3	*	20030	*	.045*	.015*	.045*
*FRS3	*	20000	*	.045*	.015*	.045*
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*FRS3	*	19650	*	.045*	.045*	.045*
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*FRS3	*	17549	*	.045*	.015*	.045*
*FRS3	*	17537	*	.045*	.015*	.045*
*FRS3	*	17531	*	.045*	.015*	.045*
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*FRS3	*	17500	*	.045*	.035*	.045*
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*FRS3	*	15742.4	*	.045*	.015*	.045*
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*FRS3	*	12216	*	.045*	.015*	.045*
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*FRS3	*	9623	* .045*	.035*	.045*
*FRS3	*	9608	* .045*	.045*	.045*
*FRS3	*	9450	* .045*	.045*	.045*
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*FRS3	*	9272.1	* .045*	.015*	.045*
*FRS3	*	9272	*Culvert *	*	*
*FRS3	*	9218.1	* .045*	.015*	.045*
*FRS3	*	9193.8	* .045*	.015*	.045*
*FRS3	*	9192.8	* .045*	.035*	.045*
*FRS3	*	9183	* .045*	.045*	.035*
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*FRS3	*	8809	* .045*	.015*	.045*
*FRS3	*	8785	* .045*	.015*	.045*
*FRS3	*	8779	* .045*	.015*	.045*
*FRS3	*	8749	* .045*	.015*	.045*
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*FRS3	*	8437	* .045*	.045*	.045*
*FRS3	*	8400	* .045*	.015*	.045*
*FRS3	*	8376	* .045*	.015*	.045*
*FRS3	*	8370	* .045*	.015*	.045*
*FRS3	*	8340	* .045*	.015*	.045*
*FRS3	*	8339	* .045*	.035*	.045*
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*FRS3	*	8004	* .045*	.045*	.045*
*FRS3	*	7970.4	* .045*	.015*	.045*
*FRS3	*	7960.4	* .045*	.015*	.045*
*FRS3	*	7958.2	*Culvert *	*	*
*FRS3	*	7907.3	* .045*	.015*	.045*
*FRS3	*	7886	* .045*	.015*	.045*
*FRS3	*	7885	* .045*	.035*	.045*
*FRS3	*	7876	* .045*	.045*	.045*
*FRS3	*	7700	* .045*	.045*	.045*
*FRS3	*	7425	* .045*	.045*	.045*
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*FRS3	*	7352	* .045*	.015*	.045*
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*FRS3	*	7321	* .045*	.035*	.045*
*FRS3	*	7306	* .045*	.045*	.045*
*FRS3	*	7150	* .045*	.045*	.045*
*FRS3	*	7030	* .045*	.045*	.045*
*FRS3	*	7000	* .045*	.015*	.045*
*FRS3	*	6982	* .045*	.015*	.045*
*FRS3	*	6976	* .045*	.015*	.045*
*FRS3	*	6946	* .045*	.015*	.045*
*FRS3	*	6945	* .045*	.035*	.045*
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*FRS3	*	6800	* .045*	.045*	.045*
*FRS3	*	6700	* .045*	.045*	.045*
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*FRS3	*	6663.16	* .045*	.015*	.045*
*FRS3	*	6661.6	*Culvert *	*	*
*FRS3	*	6570	* .035*	.015*	.035*
*FRS3	*	6550	* .035*	.015*	.035*
*FRS3	*	6200	* .035*	.015*	.035*
*FRS3	*	5920	* .035*	.015*	.035*
*FRS3	*	5902	* .035*	.015*	.035*
*FRS3	*	5600	* .035*	.015*	.035*
*FRS3	*	5400	* .035*	.015*	.035*
*FRS3	*	5342.1	*Culvert *	*	*
*FRS3	*	5220	* .035*	.015*	.035*
*FRS3	*	5193	* .035*	.015*	.035*
*FRS3	*	5181	* .035*	.015*	.035*
*FRS3	*	5100	* .035*	.015*	.035*
*FRS3	*	4800	* .035*	.015*	.035*
*FRS3	*	4748	* .035*	.015*	.035*
*FRS3	*	4740	* .035*	.015*	.035*
*FRS3	*	4729.5	*Culvert *	*	*
*FRS3	*	4650	* .035*	.015*	.035*
*FRS3	*	4600	* .035*	.015*	.035*
*FRS3	*	4350	* .035*	.015*	.035*
*FRS3	*	4278	* .035*	.015*	.035*
*FRS3	*	4271	*Culvert *	*	*
*FRS3	*	4200	* .035*	.015*	.035*
*FRS3	*	4183	* .035*	.015*	.035*
*FRS3	*	4168	* .035*	.015*	.035*
*FRS3	*	4100	* .035*	.015*	.035*
*FRS3	*	3800	* .035*	.015*	.035*
*FRS3	*	3500	* .035*	.015*	.035*
*FRS3	*	3200	* .035*	.015*	.035*
*FRS3	*	2903	* .035*	.015*	.035*
*FRS3	*	2885	* .035*	.015*	.035*
*FRS3	*	2800	* .035*	.015*	.035*
*FRS3	*	2500	* .035*	.015*	.035*
*FRS3	*	2200	* .035*	.015*	.035*
*FRS3	*	1900	* .035*	.015*	.035*
*FRS3	*	1568	* .035*	.015*	.035*
*FRS3	*	1552	* .035*	.015*	.035*
*FRS3	*	1500	* .035*	.015*	.035*
*FRS3	*	1300	* .035*	.015*	.035*
*FRS3	*	1000	* .035*	.015*	.035*

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SUMMARY OF REACH LENGTHS

River: Channel

Reach	River Sta.	Left	Channel	Right
*FRS3	31266.2	50	50	50
*FRS3	31216.2	12.7	12.7	12.7
*FRS3	31203.5	203.5	203.5	203.5
*FRS3	31000	188.5	188.5	188.5
*FRS3	30811.5	10.4	10.4	10.4
*FRS3	30801.1	4306.1	4306.1	4306.1
*FRS3	30801	*Culvert *	*	*
*FRS3	26495	20	20	20
*FRS3	26475	275	275	275
*FRS3	26200	300	300	300
*FRS3	25900	300	300	300
*FRS3	25600	301	301	301
*FRS3	25299	104	104	104
*FRS3	25195	195	195	195

*FRS3	*	25000	*	300*	300*	300*
*FRS3	*	24700	*	300*	300*	300*
*FRS3	*	24400	*	319*	319*	319*
*FRS3	*	24081	*	20*	20*	20*
*FRS3	*	24061	*	422*	422*	422*
*FRS3	*	24052.5	*Culvert	*	*	*
*FRS3	*	23639	*	20*	20*	20*
*FRS3	*	23619	*	319*	319*	319*
*FRS3	*	23300	*	300*	300*	300*
*FRS3	*	23000	*	269*	269*	269*
*FRS3	*	22731	*	20*	20*	20*
*FRS3	*	22711	*	76*	76*	76*
*FRS3	*	22704.4	*Culvert	*	*	*
*FRS3	*	22635	*	20*	20*	20*
*FRS3	*	22615	*	115*	115*	115*
*FRS3	*	22500	*	300*	300*	300*
*FRS3	*	22200	*	300*	300*	300*
*FRS3	*	21900	*	300*	300*	300*
*FRS3	*	21600	*	274*	274*	274*
*FRS3	*	21326	*	18.2*	18.2*	18.2*
*FRS3	*	21307.8	*	32.9*	32.9*	32.9*
*FRS3	*	21274.9	*	138.9*	138.9*	138.9*
*FRS3	*	21265.8	*Culvert	*	*	*
*FRS3	*	21136	*	1*	1*	1*
*FRS3	*	21135	*	20*	11*	20*
*FRS3	*	21124	*	274*	274*	274*
*FRS3	*	20850	*	270*	270*	270*
*FRS3	*	20580	*	30*	30*	30*
*FRS3	*	20550	*	12*	12*	12*
*FRS3	*	20538	*	6*	6*	6*
*FRS3	*	20532	*	30*	30*	30*
*FRS3	*	20502	*	1*	1*	1*
*FRS3	*	20501	*	20*	15*	20*
*FRS3	*	20486	*	186*	186*	186*
*FRS3	*	20300	*	223*	223*	223*
*FRS3	*	20077	*	29*	29*	29*
*FRS3	*	20048	*	12*	12*	12*
*FRS3	*	20036	*	6*	6*	6*
*FRS3	*	20030	*	30*	30*	30*
*FRS3	*	20000	*	1*	1*	1*
*FRS3	*	19999	*	20*	15*	20*
*FRS3	*	19984	*	334*	334*	334*
*FRS3	*	19650	*	340*	340*	340*
*FRS3	*	19310	*	33*	33*	33*
*FRS3	*	19277	*	10*	10*	10*
*FRS3	*	19267	*	7*	7*	7*
*FRS3	*	19260	*	8.3*	8.3*	8.3*
*FRS3	*	19251.7	*	291.7*	291.7*	291.7*
*FRS3	*	18960	*	40*	40*	40*
*FRS3	*	18920	*	580*	580*	580*
*FRS3	*	18340	*	140*	140*	140*
*FRS3	*	18200	*	300*	300*	300*
*FRS3	*	17900	*	321*	321*	321*
*FRS3	*	17579	*	30*	30*	30*
*FRS3	*	17549	*	12*	12*	12*
*FRS3	*	17537	*	6*	6*	6*
*FRS3	*	17531	*	30*	30*	30*
*FRS3	*	17501	*	1*	1*	1*
*FRS3	*	17500	*	20*	14*	20*
*FRS3	*	17486	*	136*	136*	136*
*FRS3	*	17350	*	300*	300*	300*
*FRS3	*	17050	*	271*	271*	271*
*FRS3	*	16779	*	30*	30*	30*
*FRS3	*	16749	*	12*	12*	12*
*FRS3	*	16737	*	6*	6*	6*
*FRS3	*	16731	*	5.73*	30*	30*
*FRS3	*	16701	*	1*	1*	1*
*FRS3	*	16700	*	20*	14*	20*
*FRS3	*	16686	*	186*	186*	186*
*FRS3	*	16500	*	300*	300*	300*
*FRS3	*	16200	*	216*	216*	216*

*FRS3	*	15984	*	45.3*	45.3*	45.3*
*FRS3	*	15938.7	*	20*	20*	20*
*FRS3	*	15918.7	*	176.3*	176.3*	176.3*
*FRS3	*	15918.6	*Culvert	*	*	*
*FRS3	*	15742.4	*	1*	1*	1*
*FRS3	*	15741.4	*	20*	10.4*	20*
*FRS3	*	15731	*	140*	140*	140*
*FRS3	*	15591	*	30*	30*	30*
*FRS3	*	15561	*	24*	24*	24*
*FRS3	*	15537	*	6*	6*	6*
*FRS3	*	15531	*	30*	30*	30*
*FRS3	*	15501	*	1*	1*	1*
*FRS3	*	15500	*	20*	15*	20*
*FRS3	*	15485	*	185*	185*	185*
*FRS3	*	15300	*	219*	219*	219*
*FRS3	*	15081	*	35*	35*	35*
*FRS3	*	15046	*	4*	4*	4*
*FRS3	*	15042	*	42*	42*	42*
*FRS3	*	15000	*	400*	400*	400*
*FRS3	*	14600	*	300*	300*	300*
*FRS3	*	14300	*	45*	45*	45*
*FRS3	*	14255	*	17*	17*	17*
*FRS3	*	14238	*	13*	13*	13*
*FRS3	*	14225	*	50*	50*	50*
*FRS3	*	14223.6	*Culvert	*	*	*
*FRS3	*	14175	*	25*	25*	25*
*FRS3	*	14150	*	50*	50*	50*
*FRS3	*	14100	*	200*	200*	200*
*FRS3	*	13900	*	300*	300*	300*
*FRS3	*	13600	*	304*	304*	304*
*FRS3	*	13296	*	30*	30*	30*
*FRS3	*	13266	*	18*	18*	18*
*FRS3	*	13248	*	13*	13*	13*
*FRS3	*	13235	*	50*	50*	50*
*FRS3	*	13233.5	*Culvert	*	*	*
*FRS3	*	13185	*	10*	10*	10*
*FRS3	*	13175	*	75*	75*	75*
*FRS3	*	13100	*	200*	200*	200*
*FRS3	*	12900	*	133*	133*	133*
*FRS3	*	12767	*	31*	31*	31*
*FRS3	*	12736	*	20*	20*	20*
*FRS3	*	12716	*	6*	6*	6*
*FRS3	*	12710	*	30*	30*	30*
*FRS3	*	12680	*	1*	1*	1*
*FRS3	*	12679	*	20*	14*	20*
*FRS3	*	12665	*	215*	215*	215*
*FRS3	*	12450	*	180*	180*	180*
*FRS3	*	12270	*	30*	30*	30*
*FRS3	*	12240	*	24*	24*	24*
*FRS3	*	12216	*	6*	6*	6*
*FRS3	*	12210	*	30*	30*	30*
*FRS3	*	12180	*	1*	1*	1*
*FRS3	*	12179	*	20*	15*	20*
*FRS3	*	12164	*	264*	264*	264*
*FRS3	*	11900	*	310*	310*	310*
*FRS3	*	11590	*	30*	30*	30*
*FRS3	*	11560	*	24*	24*	24*
*FRS3	*	11536	*	6*	6*	6*
*FRS3	*	11530	*	30*	30*	30*
*FRS3	*	11500	*	1*	1*	1*
*FRS3	*	11499	*	20*	15*	20*
*FRS3	*	11484	*	184*	184*	184*
*FRS3	*	11300	*	167*	167*	167*
*FRS3	*	11133	*	47.5*	47.5*	47.5*
*FRS3	*	11085.5	*	16.8*	16.8*	16.8*
*FRS3	*	11068.7	*	6*	6*	6*
*FRS3	*	11062.7	*	30*	30*	30*
*FRS3	*	11032.7	*	1*	1*	1*
*FRS3	*	11031.7	*	20*	14.5*	20*
*FRS3	*	11017.2	*	217.2*	217.2*	217.2*
*FRS3	*	10800	*	155*	155*	155*

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*FRS3          *   24400   *       .1*       .3*
*FRS3          *   24081   *       .1*       .3*
*FRS3          *   24061   *       .1*       .3*
*FRS3          *   24052.5 *Culvert  *         *
*FRS3          *   23639   *       .1*       .3*
*FRS3          *   23619   *       .1*       .3*
*FRS3          *   23300   *       .1*       .3*
*FRS3          *   23000   *       .1*       .3*
*FRS3          *   22731   *       .1*       .3*
*FRS3          *   22711   *       .1*       .3*
*FRS3          *   22704.4 *Culvert  *         *
*FRS3          *   22635   *       .1*       .3*
*FRS3          *   22615   *       .1*       .3*
*FRS3          *   22500   *       .1*       .3*
*FRS3          *   22200   *       .1*       .3*
*FRS3          *   21900   *       .1*       .3*
*FRS3          *   21600   *       .1*       .3*
*FRS3          *   21326   *       .1*       .3*
*FRS3          *   21307.8 *       .1*       .3*
*FRS3          *   21274.9 *       .1*       .3*
*FRS3          *   21265.8 *Culvert  *         *
*FRS3          *   21136   *       .1*       .3*
*FRS3          *   21135   *       .1*       .3*
*FRS3          *   21124   *       .1*       .3*
*FRS3          *   20850   *       .1*       .3*
*FRS3          *   20580   *       .1*       .3*
*FRS3          *   20550   *       .1*       .3*
*FRS3          *   20538   *       .1*       .3*
*FRS3          *   20532   *       .1*       .3*
*FRS3          *   20502   *       .1*       .3*
*FRS3          *   20501   *       .1*       .3*
*FRS3          *   20486   *       .1*       .3*
*FRS3          *   20300   *       .1*       .3*
*FRS3          *   20077   *       .1*       .3*
*FRS3          *   20048   *       .1*       .3*
*FRS3          *   20036   *       .1*       .3*
*FRS3          *   20030   *       .1*       .3*
*FRS3          *   20000   *       .1*       .3*
*FRS3          *   19999   *       .1*       .3*
*FRS3          *   19984   *       .1*       .3*
*FRS3          *   19650   *       .1*       .3*
*FRS3          *   19310   *       .1*       .3*
*FRS3          *   19277   *       .1*       .3*
*FRS3          *   19267   *       .1*       .3*
*FRS3          *   19260   *       .1*       .3*
*FRS3          *   19251.7 *       .1*       .3*
*FRS3          *   18960   *       .1*       .3*
*FRS3          *   18920   *       .1*       .3*
*FRS3          *   18340   *       .1*       .3*
*FRS3          *   18200   *       .1*       .3*
*FRS3          *   17900   *       .1*       .3*
*FRS3          *   17579   *       .1*       .3*
*FRS3          *   17549   *       .1*       .3*
*FRS3          *   17537   *       .1*       .3*
*FRS3          *   17531   *       .1*       .3*
*FRS3          *   17501   *       .1*       .3*
*FRS3          *   17500   *       .1*       .3*
*FRS3          *   17486   *       .1*       .3*
*FRS3          *   17350   *       .1*       .3*
*FRS3          *   17050   *       .1*       .3*
*FRS3          *   16779   *       .1*       .3*
*FRS3          *   16749   *       .1*       .3*
*FRS3          *   16737   *       .1*       .3*
*FRS3          *   16731   *       .1*       .3*
*FRS3          *   16701   *       .1*       .3*
*FRS3          *   16700   *       .1*       .3*
*FRS3          *   16686   *       .1*       .3*
*FRS3          *   16500   *       .1*       .3*
*FRS3          *   16200   *       .1*       .3*
*FRS3          *   15984   *       .1*       .3*
*FRS3          *   15938.7 *       .1*       .3*
*FRS3          *   15918.7 *       .1*       .3*
*FRS3          *   15918.6 *Culvert  *         *
*FRS3          *   15742.4 *       .1*       .3*
*FRS3          *   15741.4 *       .1*       .3*
*FRS3          *   15731   *       .1*       .3*
*FRS3          *   15591   *       .1*       .3*
*FRS3          *   15561   *       .1*       .3*
*FRS3          *   15537   *       .1*       .3*
*FRS3          *   15531   *       .1*       .3*
*FRS3          *   15501   *       .1*       .3*
*FRS3          *   15500   *       .1*       .3*
*FRS3          *   15485   *       .1*       .3*
*FRS3          *   15300   *       .1*       .3*
*FRS3          *   15081   *       .1*       .3*
*FRS3          *   15046   *       .1*       .3*
*FRS3          *   15042   *       .1*       .3*
*FRS3          *   15000   *       .1*       .3*
*FRS3          *   14600   *       .1*       .3*
*FRS3          *   14300   *       .1*       .3*
*FRS3          *   14255   *       .1*       .3*
*FRS3          *   14238   *       .1*       .3*
*FRS3          *   14225   *       .1*       .3*
*FRS3          *   14223.6 *Culvert  *         *
*FRS3          *   14175   *       .1*       .3*
*FRS3          *   14150   *       .1*       .3*
*FRS3          *   14100   *       .1*       .3*
*FRS3          *   13900   *       .1*       .3*
*FRS3          *   13600   *       .1*       .3*
*FRS3          *   13296   *       .1*       .3*
*FRS3          *   13266   *       .1*       .3*
*FRS3          *   13248   *       .1*       .3*
*FRS3          *   13235   *       .1*       .3*
*FRS3          *   13233.5 *Culvert  *         *
*FRS3          *   13185   *       .1*       .3*
*FRS3          *   13175   *       .1*       .3*
*FRS3          *   13100   *       .1*       .3*
*FRS3          *   12900   *       .1*       .3*
*FRS3          *   12767   *       .1*       .3*
*FRS3          *   12736   *       .1*       .3*
*FRS3          *   12716   *       .1*       .3*
*FRS3          *   12710   *       .1*       .3*
*FRS3          *   12680   *       .1*       .3*
*FRS3          *   12679   *       .1*       .3*
*FRS3          *   12665   *       .1*       .3*
*FRS3          *   12450   *       .1*       .3*
*FRS3          *   12270   *       .1*       .3*
*FRS3          *   12240   *       .1*       .3*
*FRS3          *   12216   *       .1*       .3*
*FRS3          *   12210   *       .1*       .3*
*FRS3          *   12180   *       .1*       .3*
*FRS3          *   12179   *       .1*       .3*
*FRS3          *   12164   *       .1*       .3*
*FRS3          *   11900   *       .1*       .3*
*FRS3          *   11590   *       .1*       .3*
*FRS3          *   11560   *       .1*       .3*
*FRS3          *   11536   *       .1*       .3*
*FRS3          *   11530   *       .1*       .3*
*FRS3          *   11500   *       .1*       .3*
*FRS3          *   11499   *       .1*       .3*
*FRS3          *   11484   *       .1*       .3*
*FRS3          *   11300   *       .1*       .3*
*FRS3          *   11133   *       .1*       .3*
*FRS3          *   11085.5 *       .1*       .3*
*FRS3          *   11068.7 *       .1*       .3*
*FRS3          *   11062.7 *       .1*       .3*
*FRS3          *   11032.7 *       .1*       .3*
*FRS3          *   11031.7 *       .1*       .3*
*FRS3          *   11017.2 *       .1*       .3*
*FRS3          *   10800   *       .1*       .3*
*FRS3          *   10645   *       .1*       .3*
*FRS3          *   10599.1 *       .1*       .3*
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*FRS3          *   10598    *Culvert  *        *
*FRS3          *   10535.1  *       .1*       .3*
*FRS3          *   10510.8  *       .1*       .3*
*FRS3          *   10509.8  *       .1*       .3*
*FRS3          *   10500    *       .1*       .3*
*FRS3          *   10350    *       .1*       .3*
*FRS3          *   10154    *       .1*       .3*
*FRS3          *   10124    *       .1*       .3*
*FRS3          *   10100    *       .1*       .3*
*FRS3          *   10094    *       .1*       .3*
*FRS3          *   10064    *       .1*       .3*
*FRS3          *   10063    *       .1*       .3*
*FRS3          *   10048    *       .1*       .3*
*FRS3          *   9900     *       .1*       .3*
*FRS3          *   9728     *       .1*       .3*
*FRS3          *   9675     *       .1*       .3*
*FRS3          *   9660     *       .1*       .3*
*FRS3          *   9654     *       .1*       .3*
*FRS3          *   9624     *       .1*       .3*
*FRS3          *   9623     *       .1*       .3*
*FRS3          *   9608     *       .1*       .3*
*FRS3          *   9450     *       .1*       .3*
*FRS3          *   9299     *       .1*       .3*
*FRS3          *   9272.1   *       .1*       .3*
*FRS3          *   9272     *Culvert  *        *
*FRS3          *   9218.1   *       .1*       .3*
*FRS3          *   9193.8   *       .1*       .3*
*FRS3          *   9192.8   *       .1*       .3*
*FRS3          *   9183     *       .1*       .3*
*FRS3          *   9000     *       .1*       .3*
*FRS3          *   8863     *       .1*       .3*
*FRS3          *   8809     *       .1*       .3*
*FRS3          *   8785     *       .1*       .3*
*FRS3          *   8779     *       .1*       .3*
*FRS3          *   8749     *       .1*       .3*
*FRS3          *   8748     *       .1*       .3*
*FRS3          *   8733     *       .1*       .3*
*FRS3          *   8600     *       .1*       .3*
*FRS3          *   8437     *       .1*       .3*
*FRS3          *   8400     *       .1*       .3*
*FRS3          *   8376     *       .1*       .3*
*FRS3          *   8370     *       .1*       .3*
*FRS3          *   8340     *       .1*       .3*
*FRS3          *   8339     *       .1*       .3*
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*FRS3          *   8150     *       .1*       .3*
*FRS3          *   8004     *       .1*       .3*
*FRS3          *   7970.4   *       .1*       .3*
*FRS3          *   7960.4   *       .1*       .3*
*FRS3          *   7958.2   *Culvert  *        *
*FRS3          *   7907.3   *       .1*       .3*
*FRS3          *   7886     *       .1*       .3*
*FRS3          *   7885     *       .1*       .3*
*FRS3          *   7876     *       .1*       .3*
*FRS3          *   7700     *       .1*       .3*
*FRS3          *   7425     *       .1*       .3*
*FRS3          *   7376     *       .1*       .3*
*FRS3          *   7358     *       .1*       .3*
*FRS3          *   7352     *       .1*       .3*
*FRS3          *   7322     *       .1*       .3*
*FRS3          *   7321     *       .1*       .3*
*FRS3          *   7306     *       .1*       .3*
*FRS3          *   7150     *       .1*       .3*
*FRS3          *   7030     *       .1*       .3*
*FRS3          *   7000     *       .1*       .3*
*FRS3          *   6982     *       .1*       .3*
*FRS3          *   6976     *       .1*       .3*
*FRS3          *   6946     *       .1*       .3*
*FRS3          *   6945     *       .1*       .3*
*FRS3          *   6930     *       .1*       .3*
*FRS3          *   6800     *       .1*       .3*
*FRS3          *   6700     *       .1*       .3*
*FRS3          *   6673.16  *       .1*       .3*
*FRS3          *   6663.16  *       .1*       .3*
*FRS3          *   6661.6   *Culvert  *        *
*FRS3          *   6570     *       .1*       .3*
*FRS3          *   6550     *       .1*       .3*
*FRS3          *   6200     *       .1*       .3*
*FRS3          *   5920     *       .1*       .3*
*FRS3          *   5902     *       .1*       .3*
*FRS3          *   5600     *       .1*       .3*
*FRS3          *   5400     *       .1*       .3*
*FRS3          *   5342.1   *Culvert  *        *
*FRS3          *   5220     *       .1*       .3*
*FRS3          *   5193     *       .1*       .3*
*FRS3          *   5181     *       .1*       .3*
*FRS3          *   5100     *       .1*       .3*
*FRS3          *   4800     *       .1*       .3*
*FRS3          *   4748     *       .1*       .3*
*FRS3          *   4740     *       .1*       .3*
*FRS3          *   4729.5   *Culvert  *        *
*FRS3          *   4650     *       .1*       .3*
*FRS3          *   4600     *       .1*       .3*
*FRS3          *   4350     *       .1*       .3*
*FRS3          *   4278     *       .1*       .3*
*FRS3          *   4271     *Culvert  *        *
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*FRS3          *   1000     *       .1*       .3*
*************************************************************
```

B.4 TRASHRACK HEADLOSS

WT03
Trashrack HeadLoss and Energy Grade Line

(1) Culvert #6 - 927' Box Culvert

Trash Rack Size
Width = 26 ft
Depth = 7 ft

$$H_g = 1.5\frac{V_g^2 - V_a^2}{2g}$$ (FCDMC Hydraulics Manual)

Q=	800	cfs	
Va=	4.66	fps	(Approching velocity, assuming approaching depth=6.6')
Vg=	8.79	fps	(Assuming 50% clogging, the flow area=26*7/2)
Hg=	1.29	ft	

Due to the short distance, the friction enegery loss along 100 feet upstream of the culver inlet is neglected.

Energey grade =	1172.10	ft	at culvert inlet, per BACP program results
Energey grade =	1173.39	ft	upstream of trashracck

To verify assumed approaching velocity at the upstream edge of the slope inlet,

Assumed flow depth=	6.6	ft
Va^2/2g=	0.34	ft
Invert=	1166.45	ft
Energey grade =	1173.39	ft

The difference = 1173.39 -1173.39 = 0
Therefore, the approaching depth is 6.6 ft at the drop inlet.

(2) Culvert #10 - 399' Box Culvert

Trash Rack Size
Width = 32.5 ft
Depth = 7 ft

$$H_g = 1.5\frac{V_g^2 - V_a^2}{2g}$$ (FCDMC Hydraulics Manual)

Q=	700	cfs	
Va=	3.10	fps	(Approching velocity, assuming approaching depth=6.95')
Vg=	6.15	fps	(Assuming 50% clogging, the flow area=32.5*7/2)
Hg=	0.66	ft	

Due to the short distance, the friction enegery loss along 100 feet upstream of the culver inlet is neglected.

Energey grade =	1185.57	ft	worst scenario at culvert inlet, per HEC-RAS results (subcritical, n=0.045)
Energey grade =	1186.23	ft	upstream of trashracck

To verify assumed approaching velocity at the upstream edge of the slope inlet,

Assumed flow depth=	6.95	ft
Va^2/2g=	0.15	ft
Invert=	1179.13	ft
Energey grade =	1186.23	ft

The difference = 1186.23 -1186.23 = 0
Therefore, the approaching depth is 6.95 ft at the drop inlet.

B.5 BROKEN-BACK CULVERT PERFORMANCE

WTO3
Culvert #6 BCAP

The Broken-Back Culvert Analysis Program was used to analyze the performance of Culvert #6.

The inlet control elev. is higher than the outlet control elev. and the break control elev., therefore, it is the inlet that controls upstream water surface A hydraulic jump will be contained with the culvert, which helps dissipating energy and reducing downstream erosion.

NEBRASKA DEPARTMENT OF ROADS
Broken-Back Culvert Analysis Program (BCAP)

PROJECT INFO	
Project:	WTO3
Station or Location:	Long culvert crossing Jackrabbit Trail
Date:	07 / 28 / 2010
DISCHARGE DATA	
Minimum:	300.00 cfs
Design Discharge:	800.00 cfs
Maximum:	800.00 cfs
Number of Barrels:	1
TAILWATER DATA	
Type:	Constant Elevation
Elevation:	1165.53 ft
CULVERT DATA	
Type:	Concrete Box
Span (per barrel):	16 ft
Rise:	7 ft
Inlet Type:	Headwall, 1:1 Bevel
Roughness Coefficient:	0.013
Outlet Section Roughness Coeff.:	0.013
Inlet Section Slope:	0.0037 ft/ft
Steep Section Slope:	0.0825 ft/ft
Outlet Section Slope:	0.002 ft/ft
CULVERT PROFILE DATA	
Type:	Double Broken-Back
Inlet Station:	0.00 ft
Inlet Elevation:	1165.45 ft
Upper Break Station:	300.00 ft
Upper Break Elevation:	1164.35 ft
Lower Break Station:	340.00 ft
Lower Break Elevation:	1161.05 ft
Outlet Station:	927.00 ft
Outlet Elevation:	1159.88 ft

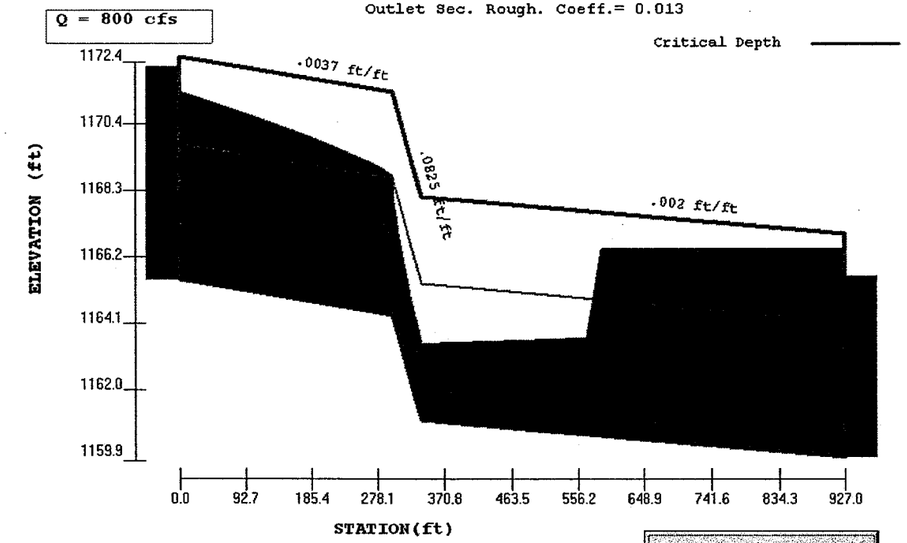
NEBRASKA DEPARTMENT OF ROADS
Broken-Back Culvert Analysis Program (BCAP)

PROJECT INFO	
Project:	WTO3
Station or Location:	Long culvert crossing Jackrabbit Trail
Date:	07/28/2010
CULVERT DATA	
Discharge:	800.0 cfs
Shape:	Box
Material:	Concrete
Size:	1-16.0 ft x 7.0 ft
Inlet Type:	Headwall, 1:1 Bevel
WATER SURFACE PROFILE	
Inlet Depth:	5.94 ft
Inlet Velocity:	8.42 ft/s
Upper Break Depth:	4.27 ft
Upper Break Velocity:	11.72 ft/s
Lower Break Depth:	2.36 ft
Lower Break Velocity:	21.23 ft/s
Depth at End of Hydraulic Jump:	6.53 ft
Velocity at End of Hydraulic Jump:	8.54 ft/s
Depth at End of Hydraulic Jump:	5.65 ft
Velocity at End of Hydraulic Jump:	0.00 ft/s
OUTPUT DATA	
Head Water Depth:	6.65 ft
Inlet Control Elevation:	1172.10 ft
Break Control Elevation:	1170.09 ft
Critical Depth:	4.27 ft
Tailwater Depth:	5.65 ft
Hydraulic Jump?	YES
Jump Station:	568.77 ft
Jump Length:	20.95 ft
Outlet Depth:	5.65 ft
Outlet Velocity:	8.85 ft/s
Outlet Froude No.:	.7

Project: WTO3 **Location: Long culvert crossing Jackrabbit Trail** **Date:**

Concrete Box Culvert
Span (per barrel)= 16 ft
Rise= 7 ft

Inlet Type
Headwall, 1:1 Bevel
Rough. Coeff.= 0.013
Outlet Sec. Rough. Coeff.= 0.013



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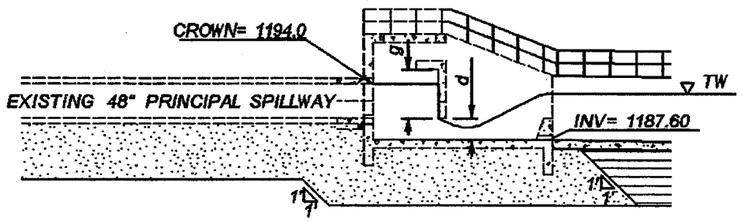
B.6 TAILWATER CONDITION OF PRINCIPAL SPILLWAY

WTO3
Tailwater at Impact Basin



Per the *Design Report for White Tanks Flood Retarding Structure No.3 Remediation Project - Phase I* (URS, 2005), the capacity for the riser and conduit is inlet controled when the reservoir water surface elevation is two feet or more above the crest of the riser. The inlet control equation was defined as follows.

$$Q = CA\sqrt{2gH}$$

where, H is the difference in elevation between the water surface in reservoir and tail water elevation which is set at crown of the pipe conduit at the outlet, i.e. 1194.0 feet (NAVD88)

Per the HEC-RAS result, the water surface elevation downstream of the impact basin is 1192.89 feet, below the crown of the 48-inch conduit. Therefore, the water surface elelvation will not create backwater condition, reduce the capacity of the riser/conduit, or impact the flow coming out of the dam.

Per the *Hydraulic Design of Stilling Basins and Energy Dissipators* (USBR, 1984), a moderate tail water depth of less than d+g/2 will improve the performance of the impact basin.

d=	2.5	ft	
g=	5.67	ft	
d+g/2=	5.34	ft	
INV=	1187.60	ft	(NAVD88)
MAX TW=	1192.94	ft	

From the HEC-RAS, the water surface elevation downstream of the impact basin is 1192.89 ft, will not impact the performance of the impact basin.

B.7 DOWNDRAIN CAPACITY

Worksheet for Downdrain - MIN S=8H:1V

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.12500	ft/ft
Normal Depth	1.00	ft
Left Side Slope	1.00	ft/ft (H:V)
Right Side Slope	1.00	ft/ft (H:V)
Bottom Width	4.00	ft

Results

Discharge	60.97	ft³/s
Flow Area	5.00	ft²
Wetted Perimeter	6.83	ft
Top Width	6.00	ft
Critical Depth	1.67	ft
Critical Slope	0.02064	ft/ft
Velocity	12.19	ft/s
Velocity Head	2.31	ft
Specific Energy	3.31	ft
Froude Number	2.35	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.00	ft
Critical Depth	1.67	ft
Channel Slope	0.12500	ft/ft
Critical Slope	0.02064	ft/ft

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Cross Section for Downdrain-MIN S=8H:1V

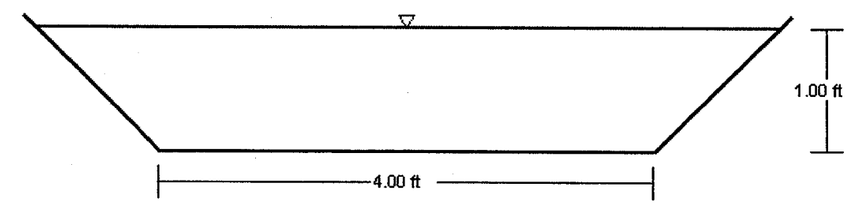
Project Description

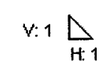
Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.12500	ft/ft
Normal Depth	1.00	ft
Left Side Slope	1.00	ft/ft (H:V)
Right Side Slope	1.00	ft/ft (H:V)
Bottom Width	4.00	ft
Discharge	60.97	ft³/s

Cross Section Image





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Worksheet for Downdrain - MAX S=4H:1V

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.25000	ft/ft
Normal Depth	1.00	ft
Left Side Slope	1.00	ft/ft (H:V)
Right Side Slope	1.00	ft/ft (H:V)
Bottom Width	4.00	ft

Results

Discharge	86.23	ft³/s
Flow Area	5.00	ft²
Wetted Perimeter	6.83	ft
Top Width	6.00	ft
Critical Depth	2.04	ft
Critical Slope	0.01998	ft/ft
Velocity	17.25	ft/s
Velocity Head	4.62	ft
Specific Energy	5.62	ft
Froude Number	3.33	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.00	ft
Critical Depth	2.04	ft
Channel Slope	0.25000	ft/ft
Critical Slope	0.01998	ft/ft

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Cross Section for Downdrain-MAX S=4H:1V

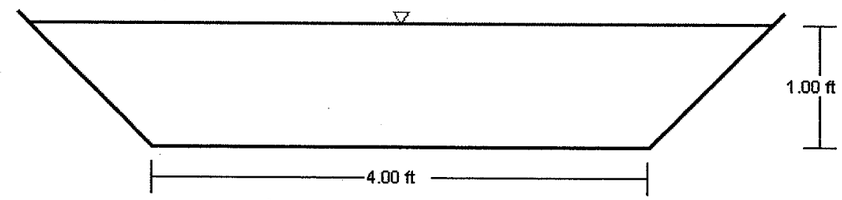
Project Description

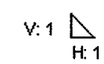
Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.25000	ft/ft
Normal Depth	1.00	ft
Left Side Slope	1.00	ft/ft (H:V)
Right Side Slope	1.00	ft/ft (H:V)
Bottom Width	4.00	ft
Discharge	86.23	ft³/s

Cross Section Image





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APPENDIX C – SEDIMENTATION ANALYSIS

C.1 MAPS OF TRIBURATY BASINS AND WASHES

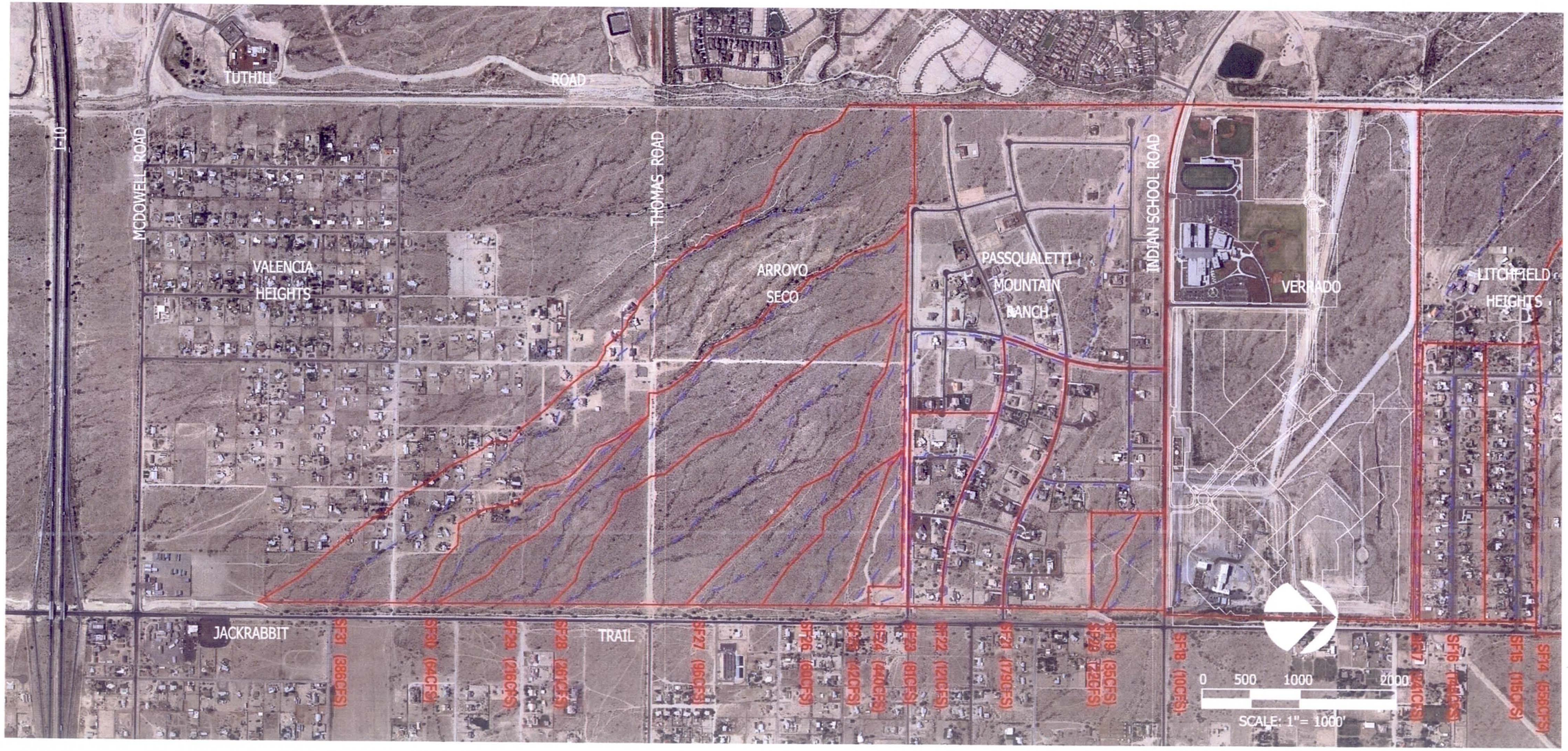

FIGURE C.1 – TRIBUTARY BASIN AND WASH MAP 1

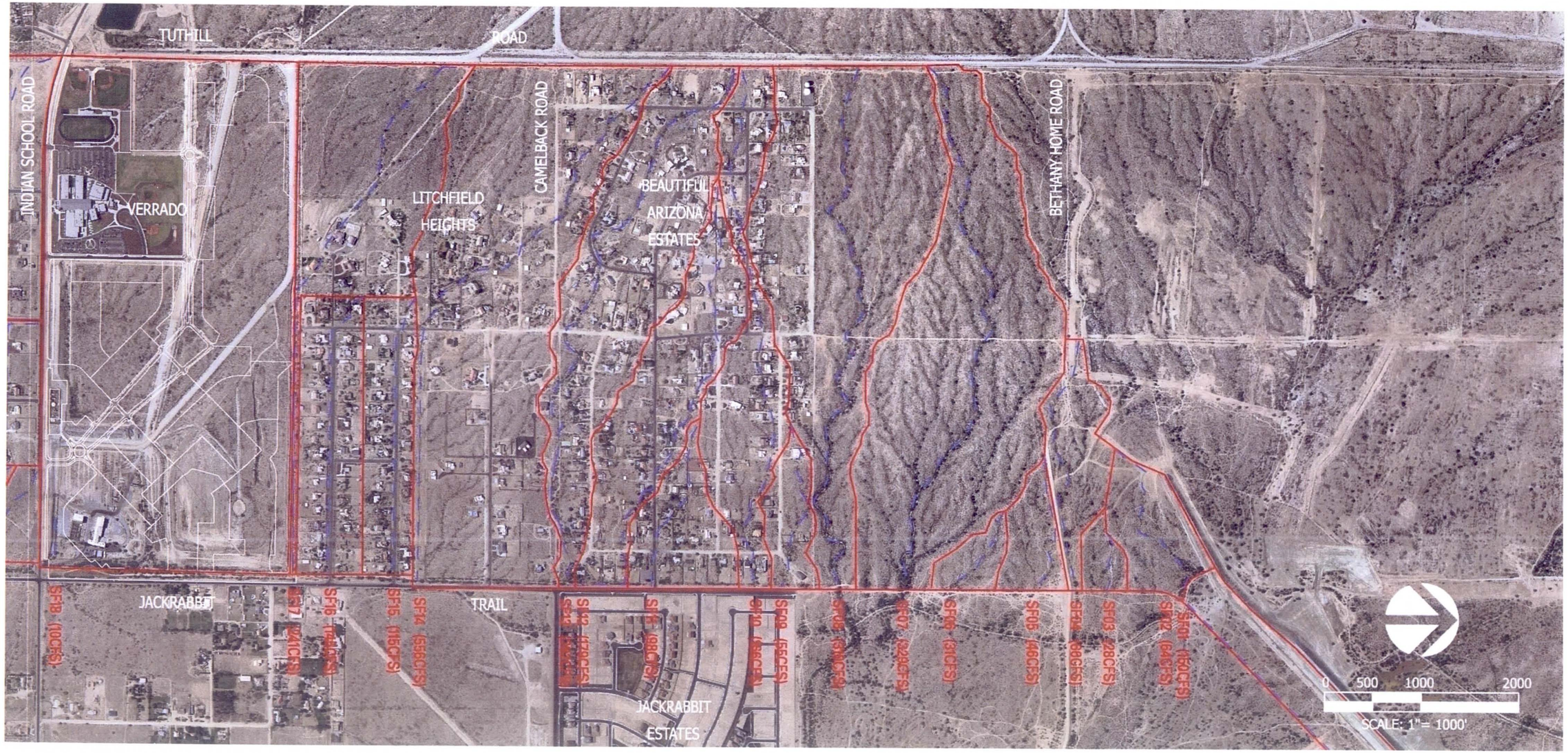

FIGURE C.2 – TRIBUTARY BASIN AND WASH MAP 2

C.2 PEAK DISCHARGES AND RUNOFF VOLUMES OF TRIBUTARY FLOWS

WT03
Peak Flow and Total Runoff Volume from Tributary Area - Input for Sediment Analysis

Note:
The runoff volumes were calculated using the equation. V=C(P/12)A, where V is volume in acre-feet, C is runoff coefficient, P is precipitation in inches, and A is surface area in acres.
The Rational Method generally overestimates runoff volumes from a large drainage area. For example, the total runoff from SF07 and SF08, whose total area is 0.47 square mile, is 62.16 acre-feet during the 100-year 24-hour storm event. While the HEC-1 model (existing condition with project-in-place) indicates that the total runoff volume from Drainage Basin W28A which covers SF07 and SF08 is 30.8 acre-feet. Therefore, a adjustment factor of 0.8 is applied to the runoff volume from tributary areas larger than 100 acres.

24-Hr Precipitation (in)

2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
1.538	1.992	2.353	2.852	3.246	3.661

Peak Flow and Total Runoff Volume

ID	Area (ac)	Runoff Volume Adjust Factor		2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
SF05	14.2	1	Peak Flow, Q (cfs)	10.7	16.2	20.5	29.3	38.1	46.2
			C	0.55	0.55	0.55	0.61	0.66	0.69
			Tc (min)	28	24	22	20	18	17
			i (in/hr)	1.37	2.07	2.62	3.38	4.07	4.71
			Volume (AF)	1.00	1.30	1.53	2.06	2.54	2.99
			Adjusted Volume (AF)	**1.00**	**1.30**	**1.53**	**2.06**	**2.54**	**2.99**
SF06	8.8	1	Peak Flow, Q (cfs)	7.7	11.4	14.1	20.2	25.5	31.3
			C	0.55	0.55	0.55	0.61	0.66	0.69
			Tc (min)	22	19	18	16	15	14
			i (in/hr)	1.6	2.36	2.91	3.76	4.4	5.16
			Volume (AF)	0.62	0.80	0.95	1.28	1.57	1.85
			Adjusted Volume (AF)	**0.62**	**0.80**	**0.95**	**1.28**	**1.57**	**1.85**
SF07	156.8	0.8	Peak Flow, Q (cfs)	70.7	112.1	144	211.3	270.1	328.8
			C	0.55	0.55	0.55	0.61	0.66	0.69
			Tc (min)	59	49	45	40	38	36
			i (in/hr)	0.82	1.3	1.67	2.21	2.61	3.04
			Volume (AF)	11.05	14.32	16.91	22.73	27.99	33.01
			Adjusted Volume (AF)	**8.84**	**11.45**	**13.53**	**18.19**	**22.39**	**26.41**
SF08	144.8	0.8	Peak Flow, Q (cfs)	71.4	109.7	141.2	201.6	262.3	309.6
			C	0.53	0.53	0.53	0.59	0.64	0.66
			Tc (min)	51	43	39	36	33	32
		28.072.5	i (in/hr)	0.93	1.43	1.84	2.36	2.83	3.24
			Volume (AF)	9.84	12.74	15.05	20.30	25.07	29.16
			Adjusted Volume (AF)	**7.87**	**10.19**	**12.04**	**16.24**	**20.05**	**23.32**
SF09	15	1	Peak Flow, Q (cfs)	14.2	20.8	25.9	36.3	45.3	54.9
			C	0.49	0.49	0.49	0.54	0.59	0.61
			Tc (min)	15	13	12	11	11	10
			i (in/hr)	1.93	2.83	3.53	4.49	5.13	6.01
			Volume (AF)	0.94	1.22	1.44	1.93	2.39	2.79
			Adjusted Volume (AF)	**0.94**	**1.22**	**1.44**	**1.93**	**2.39**	**2.79**
SF10	57.4	1	Peak Flow, Q (cfs)	41.9	61.8	78	111.4	142.9	166.4
			C	0.48	0.48	0.48	0.53	0.58	0.6
			Tc (min)	24	21	19	17	16	16
			i (in/hr)	1.52	2.24	2.83	3.66	4.29	4.83
			Volume (AF)	3.53	4.57	5.40	7.23	9.01	10.51
			Adjusted Volume (AF)	**3.53**	**4.57**	**5.40**	**7.23**	**9.01**	**10.51**
SF11	27	1	Peak Flow, Q (cfs)	27	39.6	47.6	66.9	83.6	97.5
			C	0.48	0.48	0.48	0.53	0.58	0.6
			Tc (min)	13	11	11	10	10	10
			i (in/hr)	2.08	3.05	3.67	4.67	5.33	6.01
			Volume (AF)	1.66	2.15	2.54	3.40	4.24	4.94
			Adjusted Volume (AF)	**1.66**	**2.15**	**2.54**	**3.40**	**4.24**	**4.94**
SF12	60.2	1	Peak Flow, Q (cfs)	45.1	66.4	84	119.9	149.7	179.1
			C	0.48	0.48	0.48	0.53	0.58	0.6
			Tc (min)	23	20	18	16	16	15
			i (in/hr)	1.56	2.3	2.91	3.76	4.29	4.96
			Volume (AF)	3.70	4.80	5.67	7.58	9.44	11.02
			Adjusted Volume (AF)	**3.70**	**4.80**	**5.67**	**7.58**	**9.44**	**11.02**
SF13	99.8	1	Peak Flow, Q (cfs)	67	101.5	128.8	183.5	235.5	281.9
			C	0.48	0.48	0.48	0.53	0.58	0.6
			Tc (min)	27	23	21	19	18	17
			i (in/hr)	1.4	2.12	2.69	3.47	4.07	4.71
			Volume (AF)	6.14	7.95	9.39	12.57	15.66	18.27
			Adjusted Volume (AF)	**6.14**	**7.95**	**9.39**	**12.57**	**15.66**	**18.27**
SF14	191.7	0.8	Peak Flow, Q (cfs)	136.2	200.6	253.9	362.7	464.7	555.5
			C	0.48	0.48	0.48	0.53	0.58	0.6
			Tc (min)	25	22	20	18	17	16
			i (in/hr)	1.48	2.18	2.76	3.57	4.18	4.83
			Volume (AF)	11.79	15.27	18.04	24.15	30.08	35.09
			Adjusted Volume (AF)	**9.43**	**12.22**	**14.43**	**19.32**	**24.06**	**28.07**
SF15	34.5	1	Peak Flow, Q (cfs)	29.5	42.2	54.1	76	98.8	115.2
			C	0.48	0.48	0.48	0.53	0.58	0.6
			Tc (min)	18	16	14	13	12	12
			i (in/hr)	1.78	2.55	3.27	4.16	4.94	5.57
			Volume (AF)	2.12	2.75	3.25	4.35	5.41	6.32
			Adjusted Volume (AF)	**2.12**	**2.75**	**3.25**	**4.35**	**5.41**	**6.32**
SF16	43.3	1	Peak Flow, Q (cfs)	37	53	65.4	95.4	119.2	144.6
			C	0.48	0.48	0.48	0.53	0.58	0.6
			Tc (min)	18	16	15	13	13	12
			i (in/hr)	1.78	2.55	3.15	4.16	4.75	5.57
			Volume (AF)	2.66	3.45	4.08	5.45	6.79	7.93
			Adjusted Volume (AF)	**2.66**	**3.45**	**4.08**	**5.45**	**6.79**	**7.93**
SF17	83.2	1	Peak Flow, Q (cfs)	57.5	87.1	110.2	157.4	201.7	241.1
			C	0.48	0.48	0.48	0.53	0.58	0.6
			Tc (min)	26	22	20	18	17	16
			i (in/hr)	1.44	2.18	2.76	3.57	4.18	4.83
			Volume (AF)	5.12	6.63	7.83	10.48	13.05	15.23
			Adjusted Volume (AF)	**5.12**	**6.63**	**7.83**	**10.48**	**13.05**	**15.23**
SF19	10.5	1	Peak Flow, Q (cfs)	8.6	12.6	16	23	29.1	35.1
			C	0.55	0.55	0.55	0.61	0.66	0.69
			Tc (min)	25	22	20	18	17	16
			i (in/hr)	1.48	2.18	2.76	3.57	4.18	4.83
			Volume (AF)	0.74	0.96	1.13	1.52	1.87	2.21
			Adjusted Volume (AF)	**0.74**	**0.96**	**1.13**	**1.52**	**1.87**	**2.21**
SF20	6.6	1	Peak Flow, Q (cfs)	5.1	7.7	9.8	14	17.8	21.5
			C	0.55	0.55	0.55	0.61	0.66	0.69
			Tc (min)	27	23	21	19	18	17
			i (in/hr)	1.4	2.12	2.69	3.47	4.07	4.71
			Volume (AF)	0.47	0.60	0.71	0.96	1.18	1.39
			Adjusted Volume (AF)	**0.47**	**0.60**	**0.71**	**0.96**	**1.18**	**1.39**
SF21	60.1	1	Peak Flow, Q (cfs)	45	66.4	81.6	116.6	149.5	178.9
			C	0.48	0.48	0.48	0.53	0.58	0.6
			Tc (min)	23	20	19	17	16	15
			i (in/hr)	1.56	2.3	2.83	3.66	4.29	4.96
			Volume (AF)	3.70	4.79	5.66	7.57	9.43	11.00
			Adjusted Volume (AF)	**3.70**	**4.79**	**5.66**	**7.57**	**9.43**	**11.00**
SF22	40.7	1	Peak Flow, Q (cfs)	29.7	43.7	55.2	78.9	101.2	121
			C	0.48	0.48	0.48	0.53	0.58	0.6
			Tc (min)	24	21	19	17	16	15
			i (in/hr)	1.52	2.24	2.83	3.66	4.29	4.96
			Volume (AF)	2.50	3.24	3.83	5.13	6.39	7.45
			Adjusted Volume (AF)	**2.50**	**3.24**	**3.83**	**5.13**	**6.39**	**7.45**

ID	Area (ac)	Runoff Volume Adjust Factor		2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
SF23	25.2	1	Peak Flow, Q (cfs)	20.4	29.3	37.1	51.6	67	81
			C	0.48	0.48	0.48	0.53	0.58	0.6
			Tc (min)	20	18	16	15	14	13
			i (in/hr)	1.69	2.42	3.07	3.86	4.58	5.36
			Volume (AF)	1.55	2.01	2.37	3.17	3.95	4.61
			Adjusted Volume (AF)	**1.55**	**2.01**	**2.37**	**3.17**	**3.95**	**4.61**
SF24	177.5	0.8	Peak Flow, Q (cfs)	102.2	150	195.1	278.5	367.5	439.8
			C	0.48	0.48	0.48	0.53	0.58	0.6
			Tc (min)	35	30	27	25	23	22
			i (in/hr)	1.2	1.76	2.29	2.96	3.57	4.13
			Volume (AF)	10.92	14.14	16.71	22.36	27.85	32.49
			Adjusted Volume (AF)	**8.74**	**11.31**	**13.37**	**17.89**	**22.28**	**25.99**
SF25	11.6	1	Peak Flow, Q (cfs)	11.1	16.4	20.4	28.7	35.9	41.8
			C	0.48	0.48	0.48	0.53	0.58	0.6
			Tc (min)	14	12	11	10	10	10
			i (in/hr)	2	2.94	3.67	4.67	5.33	6.01
			Volume (AF)	0.71	0.92	1.09	1.46	1.82	2.12
			Adjusted Volume (AF)	**0.71**	**0.92**	**1.09**	**1.46**	**1.82**	**2.12**
SF26	16.5	1	Peak Flow, Q (cfs)	15.3	22.4	28	39.3	51.1	59.6
			C	0.48	0.48	0.48	0.53	0.58	0.6
			Tc (min)	15	13	12	11	10	10
			i (in/hr)	1.93	2.83	3.53	4.49	5.33	6.01
			Volume (AF)	1.02	1.31	1.55	2.08	2.59	3.02
			Adjusted Volume (AF)	**1.02**	**1.31**	**1.55**	**2.08**	**2.59**	**3.02**
SF27	31.1	1	Peak Flow, Q (cfs)	23.9	35.3	43.5	62	79.4	96.3
			C	0.48	0.48	0.48	0.53	0.58	0.6
			Tc (min)	22	19	18	16	15	14
			i (in/hr)	1.6	2.36	2.91	3.76	4.4	5.16
			Volume (AF)	1.91	2.48	2.93	3.92	4.88	5.69
			Adjusted Volume (AF)	**1.91**	**2.48**	**2.93**	**3.92**	**4.88**	**5.69**
SF28	87.6	1	Peak Flow, Q (cfs)	63.9	96.7	118.9	169.9	217.8	260.6
			C	0.48	0.48	0.48	0.53	0.58	0.6
			Tc (min)	24	20	19	17	16	15
			i (in/hr)	1.52	2.3	2.83	3.66	4.29	4.96
			Volume (AF)	5.39	6.98	8.24	11.03	13.74	16.04
			Adjusted Volume (AF)	**5.39**	**6.98**	**8.24**	**11.03**	**13.74**	**16.04**
SF29	78.5	1	Peak Flow, Q (cfs)	51.6	78	98.8	140.7	180.4	216.3
			C	0.48	0.48	0.48	0.53	0.58	0.6
			Tc (min)	28	24	22	20	19	18
			i (in/hr)	1.37	2.07	2.62	3.38	3.96	4.59
			Volume (AF)	4.83	6.25	7.39	9.89	12.32	14.37
			Adjusted Volume (AF)	**4.83**	**6.25**	**7.39**	**9.89**	**12.32**	**14.37**
SF30	19	1	Peak Flow, Q (cfs)	15.8	22.7	28.8	40.5	52.4	63.6
			C	0.48	0.48	0.48	0.53	0.58	0.6
			Tc (min)	19	17	15	14	13	12
			i (in/hr)	1.73	2.49	3.15	4.01	4.75	5.57
			Volume (AF)	1.17	1.51	1.79	2.39	2.98	3.48
			Adjusted Volume (AF)	**1.17**	**1.51**	**1.79**	**2.39**	**2.98**	**3.48**
SF31	151.9	0.8	Peak Flow, Q (cfs)	88.9	131.9	172	244.7	322.4	386.3
			C	0.48	0.48	0.48	0.53	0.58	0.6
			Tc (min)	34	29	26	24	22	21
			i (in/hr)	1.22	1.81	2.36	3.04	3.66	4.24
			Volume (AF)	9.34	12.10	14.30	19.13	23.83	27.81
			Adjusted Volume (AF)	**7.48**	**9.68**	**11.44**	**15.31**	**19.07**	**22.24**

C.3 SEDIMENT YIELDS

WT03
Sediment Yield - DDMSW Output

ID		2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	Design	Annual
SF05	Peak Flow, Q (cfs)	11	16	21	29	38	46	46	
	Volume (AF)	1	1.3	1.53	2.06	2.54	2.99	2.99	
	Wash Load (AF)	0.002	0.003	0.004	0.005	0.007	0.009	0.009	0.002
	Bed Load (AF)	0.001	0.001	0.001	0.003	0.004	0.006	0.006	0.001
	Total Yield (AF)	0.00	0.00	0.01	0.01	0.01	0.02	0.015	0.003
SF06	Peak Flow, Q (cfs)	8	11	14	20	26	31	31	
	Volume (AF)	0.62	0.8	0.95	1.28	1.57	1.85	1.85	
	Wash Load (AF)	0.001	0.002	0.002	0.003	0.004	0.004	0.004	0.001
	Bed Load (AF)	0.002	0.002	0.002	0.001	0.001	0.001	0.001	0.001
	Total Yield (AF)	0.00	0.00	0.00	0.00	0.01	0.01	0.005	0.002
SF07	Peak Flow, Q (cfs)	71	112	144	211	270	329	329	
	Volume (AF)	8.84	11.45	13.53	18.19	22.39	26.41	26.41	
	Wash Load (AF)	0.012	0.019	0.024	0.034	0.044	0.054	0.054	0.013
	Bed Load (AF)	0.034	0.05	0.062	0.096	0.127	0.145	0.145	0.036
	Total Yield (AF)	0.046	0.069	0.086	0.13	0.171	0.199	0.199	0.049
SF08	Peak Flow, Q (cfs)	71	110	141	202	262	310	310	
	Volume (AF)	7.87	10.19	12.04	16.24	20.05	23.32	23.32	
	Wash Load (AF)	0.009	0.013	0.017	0.024	0.031	0.037	0.037	0.01
	Bed Load (AF)	0.043	0.065	0.083	0.124	0.122	0.132	0.132	0.046
	Total Yield (AF)	0.05	0.08	0.10	0.15	0.15	0.17	0.169	0.056
SF09	Peak Flow, Q (cfs)	14	21	26	36	45	55	55	
	Volume (AF)	0.94	1.22	1.44	1.93	2.39	2.79	2.79	
	Wash Load (AF)	0.002	0.003	0.004	0.005	0.006	0.008	0.008	0.002
	Bed Load (AF)	0.002	0.002	0.002	0.003	0.005	0.002	0.002	0.002
	Total Yield (AF)	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.004
SF10	Peak Flow, Q (cfs)	42	62	78	111	143	166	166	
	Volume (AF)	3.53	4.57	5.4	7.23	9.01	10.51	10.51	
	Wash Load (AF)	0.008	0.011	0.014	0.02	0.026	0.03	0.03	0.008
	Bed Load (AF)	0.011	0.017	0.015	0.018	0.023	0.028	0.028	0.01
	Total Yield (AF)	0.02	0.03	0.03	0.04	0.05	0.06	0.058	0.018
SF11	Peak Flow, Q (cfs)	27	40	48	67	84	98	98	
	Volume (AF)	1.66	2.15	2.54	3.4	4.24	4.94	4.94	
	Wash Load (AF)	0.003	0.005	0.006	0.008	0.01	0.012	0.012	0.003
	Bed Load (AF)								
	Total Yield (AF)	0.00	0.01	0.01	0.01	0.01	0.01	0.012	0.003
SF12	Peak Flow, Q (cfs)	45	66	84	120	150	179	179	
	Volume (AF)	3.7	4.8	5.67	7.58	9.44	11.02	11.02	
	Wash Load (AF)	0.009	0.012	0.015	0.022	0.028	0.034	0.034	0.009
	Bed Load (AF)	0.001	0.002	0.003	0.006	0.008	0.011	0.011	0.002
	Total Yield (AF)	0.01	0.01	0.02	0.03	0.04	0.05	0.045	0.011
SF13	Peak Flow, Q (cfs)	67	102	129	184	236	282	282	
	Volume (AF)	6.14	7.95	9.39	12.57	15.66	18.27	18.27	
	Wash Load (AF)	0.014	0.02	0.025	0.037	0.048	0.057	0.057	0.015
	Bed Load (AF)	0.021	0.03	0.005	0.008	0.013	0.019	0.019	0.016
	Total Yield (AF)	0.04	0.05	0.03	0.05	0.06	0.08	0.076	0.031
SF14	Peak Flow, Q (cfs)	136	201	254	363	465	556	556	
	Volume (AF)	9.43	12.22	14.43	19.32	24.06	28.07	28.07	
	Wash Load (AF)	0.022	0.031	0.039	0.056	0.073	0.088	0.088	0.023
	Bed Load (AF)	0.017	0.029	0.039	0.063	0.097	0.131	0.131	0.022
	Total Yield (AF)	0.04	0.06	0.08	0.12	0.17	0.22	0.219	0.045
SF15	Peak Flow, Q (cfs)	30	42	54	76	99	115	115	
	Volume (AF)	2.12	2.75	3.25	4.35	5.41	6.32	6.32	
	Wash Load (AF)	0.005	0.007	0.009	0.012	0.016	0.019	0.019	0.005
	Bed Load (AF)								
	Total Yield (AF)	0.01	0.01	0.01	0.01	0.02	0.02	0.019	0.005
SF16	Peak Flow, Q (cfs)	37	53	65	95	119	145	145	
	Volume (AF)	2.66	3.45	4.08	4.45	6.79	7.93	7.93	
	Wash Load (AF)	0.006	0.009	0.011	0.014	0.02	0.025	0.025	0.006
	Bed Load (AF)								
	Total Yield (AF)	0.01	0.01	0.01	0.01	0.02	0.03	0.025	0.006
SF17	Peak Flow, Q (cfs)	58	87	110	157	202	241	241	
	Volume (AF)	5.12	7.63	7.83	10.48	13.05	15.23	15.23	
	Wash Load (AF)	0.011	0.017	0.02	0.029	0.037	0.045	0.045	0.012
	Bed Load (AF)	0.024	0.036	0.038	0.059	0.078	0.095	0.095	0.025
	Total Yield (AF)	0.04	0.05	0.06	0.09	0.12	0.14	0.14	0.037

ID		2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	Design	Annual
SF19	Peak Flow, Q (cfs)	9	13	16	23	29	35	35	
	Volume (AF)	0.74	0.96	1.13	1.52	1.87	2.21	2.21	
	Wash Load (AF)	0.002	0.002	0.003	0.004	0.005	0.006	0.006	0.002
	Bed Load (AF)					0.001	0.001	0.001	
	Total Yield (AF)	0.00	0.00	0.00	0.00	0.01	0.01	0.007	0.002
SF20	Peak Flow, Q (cfs)	5	8	10	14	18	22	22	
	Volume (AF)	0.47	0.6	0.71	0.96	1.18	1.39	1.39	
	Wash Load (AF)	0.001	0.001	0.001	0.002	0.003	0.003	0.003	0.001
	Bed Load (AF)								
	Total Yield (AF)	0.00	0.00	0.00	0.00	0.00	0.00	0.003	0.001
SF21	Peak Flow, Q (cfs)	45	66	82	117	150	179	179	
	Volume (AF)	3.7	4.79	5.66	7.57	9.43	11	11	
	Wash Load (AF)	0.006	0.009	0.011	0.016	0.021	0.025	0.025	0.006
	Bed Load (AF)	0.006	0.009	0.005	0.009	0.013	0.018	0.018	0.005
	Total Yield (AF)	0.01	0.02	0.02	0.03	0.03	0.04	0.043	0.011
SF22	Peak Flow, Q (cfs)	30	44	55	79	101	121	121	
	Volume (AF)	2.5	3.24	3.83	5.13	6.39	7.45	7.45	
	Wash Load (AF)	0.004	0.005	0.007	0.01	0.013	0.015	0.015	0.004
	Bed Load (AF)	0.002	0.003	0.005	0.007	0.01	0.012	0.012	0.002
	Total Yield (AF)	0.01	0.01	0.01	0.02	0.02	0.03	0.027	0.006
SF23	Peak Flow, Q (cfs)	20	29	37	52	67	81	81	
	Volume (AF)	1.55	2.01	2.37	3.17	3.95	4.61	4.61	
	Wash Load (AF)	0.003	0.004	0.005	0.007	0.009	0.011	0.011	0.003
	Bed Load (AF)	0.002	0.003	0.003	0.005	0.004	0.004	0.004	0.002
	Total Yield (AF)	0.01	0.01	0.01	0.01	0.01	0.02	0.015	0.005
SF24	Peak Flow, Q (cfs)	102	150	195	279	368	440	440	
	Volume (AF)	8.74	11.31	13.37	17.89	22.28	25.99	25.99	
	Wash Load (AF)	0.014	0.02	0.026	0.037	0.049	0.06	0.06	0.015
	Bed Load (AF)								
	Total Yield (AF)	0.01	0.02	0.03	0.04	0.05	0.06	0.06	0.015
SF25	Peak Flow, Q (cfs)	11	16	20	29	36	42	42	
	Volume (AF)	0.71	0.92	1.09	1.46	1.82	2.12	2.12	
	Wash Load (AF)	0.002	0.003	0.003	0.005	0.006	0.007	0.007	0.002
	Bed Load (AF)								
	Total Yield (AF)	0.00	0.00	0.00	0.01	0.01	0.01	0.007	0.002
SF26	Peak Flow, Q (cfs)	15	22	28	39	51	60	60	
	Volume (AF)	1.02	1.31	1.55	2.08	2.59	3.02	3.02	
	Wash Load (AF)	0.002	0.003	0.004	0.006	0.008	0.009	0.009	0.002
	Bed Load (AF)				0.001	0.001	0.001	0.001	
	Total Yield (AF)	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.002
SF27	Peak Flow, Q (cfs)	24	35	44	62	79	96	96	
	Volume (AF)	1.91	2.48	2.93	3.92	4.88	5.69	5.69	
	Wash Load (AF)	0.004	0.006	0.008	0.011	0.014	0.018	0.018	0.004
	Bed Load (AF)		0.001	0.001	0.001	0.002	0.002	0.002	
	Total Yield (AF)	0.00	0.01	0.01	0.01	0.02	0.02	0.02	0.004
SF28	Peak Flow, Q (cfs)	64	97	119	170	218	261	261	
	Volume (AF)	5.39	6.98	8.24	11.03	13.74	16.04	16.04	
	Wash Load (AF)	0.01	0.014	0.017	0.025	0.032	0.038	0.038	0.01
	Bed Load (AF)	0.001	0.002	0.003	0.005	0.009	0.013	0.013	0.002
	Total Yield (AF)	0.01	0.02	0.02	0.03	0.04	0.05	0.051	0.012
SF29	Peak Flow, Q (cfs)	52	78	99	141	180	216	216	
	Volume (AF)	4.83	6.25	7.39	9.89	12.32	14.37	14.37	
	Wash Load (AF)	0.009	0.013	0.016	0.023	0.03	0.036	0.036	0.009
	Bed Load (AF)	0.003	0.005	0.005	0.007	0.011	0.016	0.016	0.003
	Total Yield (AF)	0.01	0.02	0.02	0.03	0.04	0.05	0.052	0.012
SF30	Peak Flow, Q (cfs)	16	23	29	41	52	64	64	
	Volume (AF)	1.17	1.51	1.79	2.39	2.98	3.48	3.48	
	Wash Load (AF)	0.003	0.004	0.005	0.008	0.01	0.012	0.012	0.003
	Bed Load (AF)	0.001	0.001			0.001	0.001	0.001	0.001
	Total Yield (AF)	0.00	0.01	0.01	0.01	0.01	0.01	0.013	0.004
SF31	Peak Flow, Q (cfs)	89	132	172	245	322	386	386	
	Volume (AF)	7.48	9.68	11.44	15.31	19.07	22.24	22.24	
	Wash Load (AF)	0.012	0.018	0.023	0.033	0.043	0.052	0.052	0.013
	Bed Load (AF)	0.025	0.005	0.007	0.013	0.022	0.03	0.03	0.013
	Total Yield (AF)	0.04	0.02	0.03	0.05	0.07	0.08	0.082	0.026

C.4 SEDIMENT BASINS

WT03 Sediment Storage

Note:

The annual sediment yield and the 100-year event yield were provided. Per the District, the storage volume is required to be not less than the 100-year event yield.

The velocities in washes and storage area are compared. The velocities in washes were from DDMSW outputs, and the velocities in storage area were estimated based on discharges and flow areas which are listed below the table.

In-line sediment trapping basins were provided for Wash SF07, SF08, SF14 and SF17. Those basins were one foot deep.

Culvert #7 was designed to divert flow from the existing channel east of Litchfield Heights to Reach 6. The drop-inlet crest of Culvert #7 was set at one foot above the bottom of the existing channel. Sediment is assumed to deposit at the sediment trapping basin upstream of the drop inlet.

The sediment of small quantities brought by side flows other than SF07, SF08, SF14 and SF 17 will be partly trapped at the drop structure aprons where velocities are below 3 fps.

Reach	Side Flow	Velocities (fps)		Sediment Quantity (AF)			Sediment Storage		
		In Washes	In Storage Area	100-Yr Event	Annual	Total	Bottom Area (AC)	Surface Area (AC)	Volume Provided (AF)
8	SF07	6.1	0.9 [1]	**0.199**	0.049	0.248	0.180	0.251	**0.215**
8	SF08	6.7	1.6 [2]	**0.169**	0.056	0.225	0.177	0.204	**0.190**
6	SF14	6.2	3 [3]	**0.219**	0.045	0.264	0.300	0.340	**0.320**
5	SF17	6.7	0.9 [4]	**0.140**	0.037	0.177	0.100	0.305	**0.193**

[1] Discharge = 500 cfs, average flow area = 600 sq ft
[2] Discharge = 700 cfs, average flow area = 450 sq ft
[3] Discharge = 300 cfs (with 256 cfs being diverted by Culvert #7), average flow area = 100 sq ft
[4] Discharge =241+300=541 cfs, flow area = 600 sq ft

APPENDIX D – EMERGENCY SPILLWAY SCOUR ANALYSIS

WT30
Emergency Spillway Scour Analysis

Note: Three soil test pits were developed at the emergency spillway, B-51, B-52 and B-53 (see Ref. 2). The average D50 is 0.59mm, average D85 is 5.0mm and the minimum D85 is 4.76mm.

Reference:
(1) Emergency Spillway Erosion Evaluation - 60 Percent Design Review for White Tanks FRS No.3 Outfall Channel, URS, May 2010
(2) White Tanks FRS No.3 Outfall Channel Final Design Geotechnical Report, Alpha, March 2010
(3) River Mechanics Manual for DDMSW (draft), FCDMC, Sep 2009
(4) Evaluating Scour at Bridges (HEC-18), FHWA, 2001

General Scour
Blench's equation (DDMS9 in Ref.3) was used

$$y_1 = Z \frac{q^{2/3}}{F_{b0}^{1/3}}$$

PMF discharge, Q=	26,838	cfs	(PMF per Ref. 1)
Emergency spillway width, w=	1,000	ft	
Emergency spillway slope, s=	0.0125	ft/ft	
Discharge per unit width, q=	26.8	ft^2/s	
Soil median size, D50=	0.0020	ft	(Average 0.59 mm for samples B51, B52 and B53, Ref. 2)
Blench's zero bed factor, F_{b0}=	1.50	ft/s^2	(Equation DDMS10, Ref. 3)
Multiplying factor, Z=	0.60		(Per DDMSW Manual, Ref. 3)
General scour depth, y_1=	**4.7**	**ft**	

Bedform Scour

DDMS 18 (Ref.3) was used.

$$y_2 = 0.5 d_h$$

$$d_h = 0.28 \pi Y_h Fr^2$$

For Fr>1.0 (Ref. 1 and 3)

Hydraulic depth, Y_h=	2.3	ft
Froud number, Fr=	1.34	
Antidune height, d_h=	3.6	ft
Bedform scour depth, y_2=	**1.82**	**ft**

Low Flow Scour

Low flow scour depth, y_3=	**1.0**	**ft**	(Ref. 1)

Local Scour downstream of the pipe crossing (Average D85)
DDMSW 34 (Ref.3) was used.

$$y_4 = K\left(\frac{q^{0.82}}{D_{85}^{0.23}}\right)\left(\frac{y_h}{q^{2/3}}\right)^{0.93} - y_h$$

K=	1.95		
Discharge, Q=	26,838	cfs	
Emergency spillway width, w=	1,000	ft	
Discharge per Unit Length, q=	26.84	cfs/ft	
Hydraulic Depth at Outlet, Y_h=	2.3	ft	
D85 =	5.0	mm	(Average)
Scour Depth, y_4=	**3.3**	**ft**	

Local Scour downstream of the pipe crossing (Minimum D85)
DDMSW 34 (Ref.3) was used.

$$y_4 = K\left(\frac{q^{0.82}}{D_{85}^{0.23}}\right)\left(\frac{y_h}{q^{2/3}}\right)^{0.93} - y_h$$

K=	1.95		
Discharge, Q=	26,838	cfs	
Emergency spillway width, w=	1,000	ft	
Discharge per Unit Length, q=	26.84	cfs/ft	
Hydraulic Depth at Outlet, Y_h=	2.3	ft	
D85 =	4.76	mm	(Min)
Scour Depth, y_4=	**3.4**	**ft**	

Total Scour Depth
$y=SF*(y_1+y_2+y_3+y_4)$

SF=	1.3	(For average D85)
	1.0	(For minimum D85)
For average D85, y=	14.1	ft
For minimum D85, y=	10.9	ft

Therefore, the total scour depth is estimated to be 14.1 ft.
However, the total scour depth of 19.6 feet estimated by URS per the following Technical Memorandum will be used for scour protection design.

WT03
Launchable Riprap Apron at Emergency Spillway

Calculations provided by FCDMC.

Per the *District Hydraulic Manual* (FCD, 1996), the launch riprap volume should be 1.5 times the volume to extend along the protection bank of 2:1 slope, and the thickness of the launch riprap should be 2 to 3 times the thickness expected to launch along the protection bank of 2:1 slope.

Key:
Input
Results

Upstream Lauchable Riprap

scour from URS report, excludes local scour

Scour Depth, ft =	10
Length of 2:1 slope, ft =	22.4
Thickness of Riprap, ft =	3.33333
Cross-sectional Area, ft^2 =	74.5
SF =	1.5
Total Area Needed =	111.8 ft^2
Thickness of Launchable, ft =	7
Is it 2T < t < 3T?	Yes
Length of Toe =	16.0 ft

7'X16' riprap is selected for the upstream design.

Downstream Lauchable Riprap

scour from URS report

Scour Depth, ft =	20
Length of 2:1 slope, ft =	44.7
Thickness of Riprap, ft =	3.33333
Cross-sectional Area, ft^2 =	149.1
SF =	1.5
Total Area Needed =	223.6 ft^2
Thickness of Launchable, ft =	7
Is it 2T < t < 3T?	Yes
Length of Toe =	31.9 ft

7'X40' riprap is selected for the downstream design.

Technical Memorandum

URS

7720 N. 16th Street
Suite 100
Phoenix, Arizona 85020
602.371.1100 Tel
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Action	Info	File
Mike Greenslade – District		23445887

From: Todd Ringsmuth, P.E.

Date: October 12, 2010

Subject: Emergency Spillway Erosion Evaluation
90 Percent Design Review
White Tanks FRS No. 3 Outfall Channel

Registered Professional Engineer (Civil) CERTIFICATE NO. 32847 TODD E. RINGSMUTH Date Signed 10/12/10 ARIZONA, U.S.A.
Expires 9/30/13

The purpose of this memorandum is to present the Emergency Spillway erosion evaluation for the proposed 90 percent design documents prepared by Hoskin-Ryan Consultants for the above referenced project. URS Corporation (URS) performed a design review at the request of the Flood Control District of Maricopa County (District). The proposed design includes construction of buried, concrete-covered pipelines across the White Tanks FRS No. 3 Emergency Spillway downstream channel and modification to the existing Principal Spillway outlet structure. The comments provided in this memorandum specifically relate to the erosion evaluation performed by URS for the Emergency Spillway downstream channel.

The White Tanks FRS No. 3 Emergency Spillway and downstream channel are designed to meet ADWR and NRCS criteria, whichever is more stringent. This memorandum presents a discussion of the design criteria, details of the analyses performed, and recommendations for design modifications.

Hoskin-Ryan Design

Hoskin-Ryan prepared 90 percent design documents for the proposed outfall channel. The outfall channel will convey stormwater from the White Tanks FRS No. 3 Principal Spillway to White Tanks FRS No. 4. The design includes two buried, parallel pipelines crossing the Emergency Spillway downstream channel. Within the limits of the Emergency Spillway downstream channel, the pipelines will be covered by concrete slurry, with the concrete flush to channel bottom. Riprap is provided upstream and downstream of the concrete-encased pipelines to provide erosion protection during an Emergency Spillway discharge event. The riprap downstream of the pipelines extends approximately 100 feet downstream of the pipelines and 20 feet below the channel bottom. Details are shown on Drawing No. D13 provided in Appendix A.

ADWR Design Requirements

ADWR requires the spillway be designed to safely convey the 6-hour Local Storm PMF. To meet ADWR design criteria, scour depths were estimated immediately downstream of the concrete spillway structure and within the channel to determine the depths of erosion protection. The scour depth at the concrete spillway structure was estimated by combining general scour, calculated using the Blench Equation, and local scour, calculated using the Zimmerman and Maniak Equation (USBR 1984). The scour depth for along the dikes was estimated by calculating general scour using the Blench Equation. The equations used to estimate scour were identified through coordination with the District.

ADWR required the scour calculation be performed in two ways:

1) Using the average particle size and a 1.3 factor of safety; and
2) Using the minimum particle size and a 1.0 factor of safety

The approach resulting in the greater scour depth is selected for design. The scour depth for the dikes, based on the general scour equation, was calculated to be approximately 10 feet for both the average and minimum particle size approaches. Immediately downstream of the spillway structure, local scour was added to the general scour, resulting in a total scour of 13.3 feet (average) and 19.6 (minimum). The design scour depth at the spillway structure was selected as 20 feet.

The Hoskin Ryan design consists of concrete-covered pipelines constructed across the Emergency Spillway downstream channel and dikes. URS has interpreted the concrete cover as an erosion control structure as described in *Computing Degradation and Local Scour* (USBR 1984). General scour immediately downstream of the pipelines could create a drop condition, increasing the potential for local scour to occur. Therefore, the potential scour at the downstream side of the pipelines is similar to that immediately downstream of the concrete spillway structure, or 19.6 feet. The calculation of scour depth based on ADWR criteria is provided in Appendix B.

NRCS Design Requirements

NRCS requires the spillway be designed to maintain spillway integrity and provide spillway stability during conveyance of the corresponding design storms. The spillway integrity is evaluated using the 24-hour General Storm PMF and spillway stability is evaluated using the Emergency Spillway Hydrograph (ESH). The NRCS SITES erosion model was used to evaluate headcut erosion in the spillway channel.

The design conducted for the White Tanks FRS No. 3 Phase 2 Project consisted of evaluating the left and right sides of the spillway channel (looking downstream). Field investigations showed the left side of the spillway channel to have thicker zones of more erodible soils than the right side. The presence of thicker zones of more erodible soils in the left profile resulted in the SITES model showing greater headcut erosion on the left side of the spillway channel. The SITES modeling was also performed for a range of natural ground slopes downstream of the spillway

URS
Comments on the 90 Percent Design
White Tanks FRS No. 3 Outall Channel
October 12, 2010
Page 3

channel, with the 2.0 percent natural ground slope resulting in the worst case erosion. The results of the SITES modeling from the spillway design are presented in Table 1.

TABLE 1
SITES Model Results

Erosion Location	Emergency Spillway Hydrograph (ESH)				24-hour General Storm			
	Left Profile		Right Profile		Left Profile		Right Profile	
	Depth (ft)	Distance[3] (ft)	Depth (ft)	Distance[3] (ft)	Depth (ft)	Distance[3] (ft)	Depth (ft)	Distance[3] (ft)
Erosion at riprap apron[1,2]	0	N/A	0	N/A	9.1	N/A[1]	9.1	N/A[1]
Downstream Erosion (with 2.0 percent natural ground slope)	10.9	1,288	10.9	1,288	20.2	1,017	12.0	1,142

Notes:
1) In all models, riprap does not erode.
2) The erosion depth at the riprap apron does not change with downstream natural ground slope beyond the constructed channel.
3) Distance is measured from the Emergency Spillway crest. The end of the spillway channel is approximately 1,400 feet from the spillway crest.

The results of the SITES modeling indicate that a headcut depth of 20.2 feet could encroach to within 1,017 feet of the concrete Emergency Spillway structure. The proposed pipelines cross the left dike at approximately 1,000 feet downstream of the Emergency Spillway structure.

Since the left profile provides the worst case headcut erosion assessment, only the left profile was evaluated for review of the Outfall Channel 90 percent design. URS assumed that the proposed manhole located at the center of the spillway channel would be flush to the top of concrete and would therefore not cause increased erosion in the channel. The SITES model for the left profile was revised to include the proposed concrete-covered pipelines to evaluate the effect on headcut erosion within the spillway channel. The results of the SITES modeling when incorporating the pipelines are presented in Table 2.

URS
Comments on the 90 Percent Design
White Tanks FRS No. 3 Outall Channel
October 12, 2010
Page 4

TABLE 2
SITES Model Results – Outfall Channel Design

Erosion Location	Emergency Spillway Hydrograph (ESH)		24-hour General Storm	
	Left Profile		Left Profile	
	Depth (ft)	Distance[3] (ft)	Depth (ft)	Distance[3] (ft)
Erosion at riprap apron[1,2]	0	N/A[1]	12.2	N/A[1]
Downstream Erosion (with 2.0 percent natural ground slope)	10.9	1,288	19.7	1,061

Notes:
1) In all models, riprap does not erode.
2) The erosion depth at the riprap apron does not change with downstream natural ground slope beyond the constructed channel.
3) Distance is measured from the Emergency Spillway crest. The end of the spillway channel is approximately 1,400 feet from the spillway crest.

The results of the SITES modeling indicate that the headcut erosion and distance from the Emergency Spillway structure is unchanged for the ESH. For the 24-hour General Storm model, the headcut erosion immediately downstream of the pipelines is estimated to be 19.7 feet deep. The headcut erosion at the Emergency Spillway structure increases to 12.2 feet deep for the 24-hour General Storm model. The SITES models developed for this evaluation are provided in Appendix C.

Additional Scour Analysis

URS evaluated the scour downstream of the pipelines following the scour methods used to meet ADWR design criteria. The scour depths for the ESH were estimated to be 5.5 feet and 7.5 feet for the average and minimum particle sizes, respectively. The scour depths for the 24-hour General Storm PMF were estimated to be 11.5 feet and 16.7 feet for the average and minimum particle sizes, respectively. The calculation of scour depth based on NRCS criteria is provided in Appendix B.

Conclusions and Recommendations

Construction of the pipelines across the Emergency Spillway downstream channel will change the potential for erosion within the channel. The pipelines must be protected to prevent increased erosion upstream of the pipelines towards the concrete Emergency Spillway structure and erosion through the left dike towards the dam embankment.

Based on ADWR design criteria, the estimated scour depth downstream of the concrete-covered pipelines is 19.6 feet. The proposed design, consisting of a riprap launch apron downstream of the concrete-covered pipelines, should be sufficient to protect the pipelines and dikes against scour erosion estimated using ADWR design criteria.

URS
Comments on the 90 Percent Design
White Tanks FRS No. 3 Outall Channel
October 12, 2010
Page 5

For the NRCS design criteria, scour depths were estimated for the ESH and the 24-hour General Storm PMF for the condition with the proposed pipelines and compared to the original design models without the pipelines. The results of the SITES modeling with the proposed pipelines for the ESH showed no change in scour depths or scour locations within the spillway channel. The results of the SITES modeling with the proposed pipelines for the 24-hour General Storm showed an increase in headcut depth to 12.2 feet at the Emergency Spillway structure and a decrease in headcut depth to 19.7 feet at the pipelines. The increased headcut at the Emergency Spillway structure is likely caused by the addition of the pipelines within the profile thus causing headcut to begin at the pipeline location. The increased headcut depth at the Emergency Spillway structure is shallower than the design depth and would be contained by the riprap apron downstream of the structure. The reduced headcut at the concrete-covered pipelines is likely a function of the concrete-covered pipelines halting the headcut advance, but assumes the concrete structure would remain in place during headcutting. The scour analysis shows that scour depths immediately downstream of the encased pipelines could range from 5.5 to 7.5 feet for the ESH and from 11.5 to 16.7 for the 24-hour General Storm.

The proposed design, consisting of a riprap launch apron downstream of the concrete-covered pipelines, should be sufficient to protect the pipelines and dikes against scour and headcut erosion estimated using the NRCS design criteria. In the event that headcut or scour erodes the dikes, the transverse riprap constructed through the dikes at Emergency Spillway Station 55+00 will protect against upstream erosion of the dikes.

The SITES modeling for the 24-hour General Storm PMF shows increased headcut erosion of 12.2 feet approaching the Emergency Spillway structure. The Emergency Spillway structure would be protected by the riprap apron at the downstream edge of the structure, which is designed for erosion depths of 20 feet. However, the riprap on the dikes immediately downstream of the Emergency Spillway structure is designed to protect against erosion to depths of 10 feet. Therefore, URS recommends the depth of riprap on the left and right dikes be increased to 12 feet below the channel bottom between the downstream edge of the Emergency Spillway structure and Emergency Spillway Station 47+00.

URS also recommends the District and Hoskin-Ryan evaluate the quantity of riprap proposed for the riprap apron downstream of the concrete-covered pipelines. The riprap apron at the pipelines could be designed similar to the riprap apron at the Emergency Spillway structure, thus reducing the quantity of riprap required. If this change is made, the depth of the riprap on the dikes should be maintained as shown on the drawings (see Appendix A) at a depth 20 feet below the channel bottom and a distance of 40 feet downstream of the pipelines.

Adobe versions of the memorandum and appendices, and the electronic versions or the scour and SITES models, are provided in Appendix D.

References

USBR 1984. *Computing Degradation and Local Scour.* Pemberton, E. L., Lara, J. M. United States Bureau of Reclamation.

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ATTACHMENT B

SCOUR ANALYSIS

URS **EXHIBIT 4.7-2**

CALCULATION COVER SHEET

Client: FCDMC Project Name: White Tanks FRS No. 3

Project/Calculation Number: 23445887

Title: Scour Calculation of Emergency Spillway Channel

Total Number of Pages (including cover sheet): _____

Total Number of Computer Runs: _____

Prepared by: Michael Johnson, E.I.T. Date: 5/6/2010

Checked by: Todd Ringsmuth Date: 5/7/10

Description and Purpose:
Determine the scour depth within the emergency spillway channel in regards to the proposed concrete encased pipeline structure.

Design Basis/References/Assumptions
See Page 2

Remarks/Conclusions/Results:
See Page 3

Calculation Approved by: Todd Ringsmuth 5/7/10
Project Manager/Date

Revision No.:	Description of Revision:	Approved by:

Project Manager/Date

SCOUR CALCULATION for
the PROPOSED PIPELINE STRUCTURE
WHITE TANKS FRS No. 3
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY (FCDMC)

Problem Statement

Determine the scour depth downstream of White Tanks FRS No. 3 within the excavated Emergency Spillway channel at the proposed concrete-encased pipeline structure.

Deliverables

- Total scour depths at the proposed pipeline structure

Design Basis and Assumptions

The peak outflows released from the Emergency Spillway at White Tank FRS No. 3 will be discharged into a channel (referred as the Emergency or Auxiliary Spillway Downstream Channel) with a bottom width of approximately 1,000 ft and spillway dike side slopes of 2.5 to 1 (H:V). The Emergency Spillway Downstream Channel slopes at 1.25 percent until the channel daylights downstream and transitions into natural grade.

Three possible storms were evaluated 1) the Emergency Spillway Hydrograph (ESH) for evaluation of spillway stability, 2) the 24-hour General Storm Probable Maximum Flood (PMF) for evaluation of spillway integrity, in accordance with Earth Dams and Reservoirs, TR-60 (NRCS 2005), and 3) the 6-hour Local Storm PMF. The design peak flow is 6,455 cfs for the ESH; 20,983 cfs for the 24-hour storm; and 26,838 cfs for the 6-hour storm. Flowmaster© was used to calculate the flow characteristics for each storm discharge and are attached.

The Flood Control District of Maricopa County (FCDMC) is proposing to add a concrete-encased pipeline structure through the Emergency Spillway downstream channel. The top of the proposed pipeline structure is shown to be flush with the final grade of the spillway channel. URS has interpreted this structure to be an erosion control structure for the purpose of this calculation. The concrete can not erode per say, but will upset the hydraulics within the channel and will cause general and local scour to occur downstream of the structure. Based on the 60 percent design plans for the proposed pipeline structure there is also a downstream cutoff wall adjacent to the concrete encased pipelines, which measures 13 feet deep and 1 foot wide.

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General Scour

The scour depth for the proposed pipeline structure was calculated based on the FCDMC Hydraulic Design Manual, as well as the USBR Technical guidance *"Computing Degradation and Local Scour"* (1984). The scour depth was initially calculated with the average particle size and a factor of safety of 1.3. Next, the scour depth was calculated using the minimum particle size and a factor of safety of 1.0. The calculation spreadsheets are attached. The tables below summarize the scour depths calculated. The Blench equation was used to calculate the general scour at the proposed pipeline structure.

Emergency Spillway Hydrograph

$Z_{general}$	Z_{local}	Z_{bend}*	$Z_{bedform}$	$Z_{low\text{-}flow}$	Factor of Safety	Total General Scour, Zt
ft	ft	ft	Ft	ft		ft
Average D_{85} Particle Size						
1.91	0.00	0.00	0.59	1.0	1.3	4.6
Minimum D_{85} Particle Size						
2.84	0.00	0.00	0.59	1.0	1.0	4.4

24-hour General Storm PMF

$Z_{general}$	Z_{local}	Z_{bend}*	$Z_{bedform}$	$Z_{low\text{-}flow}$	Factor of Safety	Total General Scour, Zt
ft	ft	ft	Ft	ft		ft
Average D_{85} Particle Size						
4.21	0.00	0.00	1.49	1.0	1.3	8.7
Minimum D_{85} Particle Size						
6.26	0.00	0.00	1.49	1.0	1.0	8.8

6-hr Local Storm PMF
Current Design for Emergency Spillway Apron

$Z_{general}$	Z_{local}	Z_{bend}*	$Z_{bedform}$	$Z_{low\text{-}flow}$	Factor of Safety	Total General Scour, Zt
ft	ft	ft	Ft	ft		ft
Average D_{85} Particle Size						
4.97	0.00	0.00	1.81	1.0	1.3	10.1
Minimum D_{85} Particle Size						
7.38	0.00	0.00	1.81	1.0	1.0	10.2

A Factor of Safety of 1.0 was chosen when using the minimum particle size to determine the maximum scour depth possible, which is approximately equal to the scour depth when using the average particle size and a factor of safety of 1.3. The design scour depth based on general scour was selected to be 10.0 ft.

Local Scour

The USBR technical guidance provides several equations for determining scour below a structure. The Schoklitsch and Veronese equations lean heavily on the head differential within the structure and were not computed. The Zimmerman and Maniak equation is more applicable to this design scenario and relies on the unit discharge, channel velocity, and soil particle size. The maximum channel velocity was used in computing the scour at the structure, but the water exiting the stilling basin should be subcritical. The scour at the proposed pipeline structure was determined from the Zimmerman and Maniak (1967) equation as shown below:

$$d_s = K\left(\frac{q^{0.82}}{D_{85}^{0.23}}\right)\left(\frac{d_m}{q^{2/3}}\right)^{0.93} - d_m$$

Where,

K = 1.95 inch-pounds

q = design discharge per unit width, (cfs/ft) = 26.838 cfs/ft

D_{85} = particle size for which 85 percent is finer than (mm)

Average D_{85} = 5.580 mm (geotechnical data attached)

Minimum D_{85} = 0.20 mm (geotechnical data attached)

d_m = downstream channel depth, (ft) = 2.31 ft

d_s = depth of scour below streambed, (ft)

In accordance with FCDMC procedures, the Factor of Safety was intentionally omitted from the local scour depth calculation at the spillway structure, since the Zimmerman and Maniak equation is considered to be conservative. The local scour depth is then added to the general scour depth to calculate total required scour depth below the encased pipeline structure. Similar to the general scour depth calculation, the local scour depth at the proposed pipeline structure was calculated using the average and minimum particle sizes, and is summarized in the table below.

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Local Scour Depth Summary

Zimmerman and Maniak	Average D_{85} Scour Depth (ft)	Minimum D_{85} Scour Depth (ft)
Emergency Spillway Hydrograph	1.0	3.0
24-hr General Storm	2.5	7.7
6-hr Local Storm (current design at Emergency Spillway structure)	3.2	9.5

Total Scour Depth Summary

Storm	Scour Depth based on Average Particle Size (ft)	Scour Depth based on Minimum Particle Size (ft)
Emergency Stability Hydrograph	5.5	7.5
24hr General Storm	11.5	16.7
6hr Local Storm	13.2	19.5

Note: Total scour depths have been rounded and may not exactly match the addition of local and general scour depths show in previous tables.

References

Bentley Systems, Inc,FlowMaster, (2005).

Hydraulics Drainage Design Manual, (2003 Draft). *Flood Control District of Maricopa County*

Pemberton, E.L., Lara, J.M. (1984). "Computing Degradation and Local Scour", *United States Bureau of Reclamation.*

FCMDC, 60percent design plans for the construction of the FRS No.3 Outfall Channel, April 2010.

Emergency Spillway Hydrograph Hydraulics

Project Description			
Friction Method	Manning Formula		
Solve For	Normal Depth		
Input Data			
Roughness Coefficient		0.025	
Channel Slope		1.25000	%
Left Side Slope		2.50	ft/ft (H:V)
Right Side Slope		2.50	ft/ft (H:V)
Bottom Width		1000.00	ft
Discharge		6455.00	ft^3/s
Results			
Normal Depth		0.98	ft
Flow Area		984.60	ft^2
Wetted Perimeter		1005.29	ft
Top Width		1004.91	ft
Critical Depth		1.09	ft
Critical Slope		0.00887	ft/ft
Velocity		6.56	ft/s
Velocity Head		0.67	ft
Specific Energy		1.65	ft
Froude Number		1.17	
Flow Type	Supercritical		
GVF Input Data			
Downstream Depth		0.00	ft
Length		0.00	ft
Number Of Steps		0	
GVF Output Data			
Upstream Depth		0.00	ft
Profile Description			
Profile Headloss		0.00	ft
Downstream Velocity		Infinity	ft/s
Upstream Velocity		Infinity	ft/s
Normal Depth		0.98	ft
Critical Depth		1.09	ft
Channel Slope		0.01250	ft/ft
Critical Slope		0.00887	ft/ft

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5/6/2010 5:30:01 PM 27 Siemons Company Drive Suite 200 W Watertown, CT 06795 USA +1-203-755-1666 Page 1 of 2

P:\WRES\FCDMC\23445608_WHITE TANKS_PHASE 2 CONSTRUCTION\DOWNSTREAM CHANNEL DESIGN REVIEW\SCOUR CALCULATION\SPILLWAY SCOUR CALCULATION.DOC

White Tanks FRS No. 3
Downstream Channel Scour Calculation

Calculation of Scour Depth for Emergency Spillway Hydrograph

(Calculations are based on Maricopa County Hydraulic Design Manual)

Channel: White Tanks DS Channel (S = 1.25%)

Location: Emergency Spillway Channel Bank and Spillway Structure

Total Scour, $$Z_t = FS\left(Z_{long-term} + Z_{general} + Z_{local} + Z_{bend} + Z_{bedform} + Z_{low-flow}\right)$$

Where,

FS = Factor of Safety (with the most commonly used value of 1.3)
$Z_{long-term}$ = Long-term scour
$Z_{general}$ = General scour
Z_{local} = Local scour
Z_{bend} = Bend scour
$Z_{bedform}$ = Bedform scour
$Z_{low-flow}$ = Low-flow scour

Equations for each scour component:

Long-Term Scour

$Z_{long-term}$ = N/A long-term scour not applicable because the spillway flows only during the PMF

General scour

$$Z_{general} = d_{fo} = \frac{q_f^{\frac{2}{3}}}{F_{bo}^{\frac{1}{3}}},\quad d_s = Zd_{fo}$$ Blench Equation

Where,
d_{fo} = Depth for zero bed sediment transport, ft
q_f = Design flood discharge per unit width, $ft^3/s/ft$
F_{bo} = Blench's "zero bed factor" in ft/s^2 (see attached graph) D_{50}= 0.44
d_s = Depth of scour, ft
Z = Multiplying factor for Blench regime, 0.6

Local scour

Z_{local} = N/A (scour for bridge/culvert, calculated separately where appropriate)

Bend scour

$$Z_{bend} = Y_{max}\frac{0.0685V_m^{0.8}}{Y_h^{0.4}S_e^{0.3}}\left(2.1\left[\frac{\sin^2(\alpha/2)}{\cos\alpha}\right]^{0.2}\right) - 1$$

Where,
α = Angle between point of curvature and channel centerline
Z_{bend} = 0, when α ≤17.8

Bedform scour

$$Z_{bedform} = 0.5d_h$$

$$d_h = 0.066\ Y_h^{1.21}$$ (for dune height calculation) Fr<0.7

$$d_h = 0.28\pi Y_h Fr^2$$ (for antidune height calculation) Fr>0.7

Where,
d_h = Dune or Antidune height, ft
Y_h = Hydraulic depth, ft
V = Channel average velocity, ft/s
Fr = Froude #

White Tanks FRS No. 3
Downstream Channel Scour Calculation

Low-flow scour

$Z_{low-flow}$ = 1 ft. of scour (The spillway flows only during the PMF, so 1.0 ft was assumed to be conservative)

Local Scour at Stilling Basin

Zimmerman and Maniak equation for local scour below a stilling basin

$$d_s = K\left(\frac{q^{0.82}}{D_{85}^{0.23}}\right)\left(\frac{d_m}{q^{0.67}}\right)^{0.93} - d_m$$

d_s = Depth of Scour below streambed, ft
K = 1.95 inch-pound units
q = Design discharge per unit width, $ft^3/s/ft$
D_{85} = Particle size for which 85 percent is finer than, mm 5.58
d_m = Downstream mean water depth, ft

Input Data and Scour Calculation

Input Data: (Output from Flowmaster)

Discharge q, 100yr	Channel Velocity, V_m	Maximum Depth, Y_{max}	Flow Area	Top Width	Hydraulic Depth, Y_h	Energy Slope, S_e	Froude Number	Bend Angle α	Manning's Roughness, n	Blench's zero bed factor
cfs/ft	ft/s	ft	sf	ft	ft	ft/ft		degrees		ft/s^2
6.46	6.56	0.98	985	1.005	0.98	0.0125	1.17	0	0.025	4.31

(*Comments: Straight channel; hence input bend angle is zero)

Scour Calculation:

$Z_{general}$	Z_{local}	Z_{bend}*	$Z_{bedform}$	$Z_{low-flow}$	F.S.	Total Channel Scour, Zt	Local Scour Depth at Basin	Total Scour at Basin Toe
ft	ft	ft	ft	ft		ft	ft	ft
1.91	0.00	0.00	0.59	1.0	1.3	4.55	0.88	5.4

White Tanks FRS No. 3
Downstream Channel Scour Calculation

Calculation of Scour Depth for Emergency Spillway Hydrograph

(Calculations are based on Maricopa County Hydraulic Design Manual)

Channel: White Tanks DS Channel (S = 1.25%)

Location: Emergency Spillway Channel Bank and Spillway Structure

Total Scour,

$$Z_t = FS\left(Z_{long-term} + Z_{general} + Z_{local} + Z_{bend} + Z_{bedform} + Z_{low-flow}\right)$$

Where,

FS = Factor of Safety (with the most commonly used value of 1.3)
$Z_{long-term}$ = Long-term scour
$Z_{general}$ = General scour
Z_{local} = Local scour
Z_{bend} = Bend scour
$Z_{bedform}$ = Bedform scour
$Z_{low-flow}$ = Low-flow scour

Equations for each scour component:

Long-Term Scour

$Z_{long-term}$ = N/A long-term scour not applicable because the spillway flows only during the PMF

General scour

$$Z_{general} = d_{fo} = \frac{q_f^{\frac{2}{3}}}{F_{bo}^{\frac{1}{3}}},\quad d_s = Zd_{fo}$$

Blench Equation

Where,
d_{fo} = Depth for zero bed sediment transport, ft
q_f = Design flood discharge per unit width, $ft^3/s/ft$
F_{bo} = Blench's "zero bed factor" in ft/s^2 (see attached graph) D_{50}= 0.04
d_s = Depth of scour, ft
Z = Multiplying factor for Blench regime, 0.6

Local scour

Z_{local} = N/A (scour for bridge/culvert, calculated separately where appropriate)

Bend scour

$$Z_{bend} = Y_{max}\frac{0.0685V_m^{0.8}}{Y_h^{0.4}S_e^{0.3}}\left(2.1\left[\frac{\sin^2(\alpha/2)}{\cos\alpha}\right]^{0.2}\right)-1$$

Where,
α = Angle between point of curvature and channel centerline
Z_{bend} = 0, when α ≤17.8

Bedform scour

$$Z_{bedform} = 0.5d_h$$

$$d_h = 0.066\ Y_h^{1.21}$$ (for dune height calculation) Fr<0.7

$$d_h = 0.28\pi Y_h Fr^2$$ (for antidune height calculation) Fr>0.7

Where,
d_h = Dune or Antidune height, ft
Y_h = Hydraulic depth, ft
V = Channel average velocity, ft/s
Fr = Froude #

White Tanks FRS No. 3
Downstream Channel Scour Calculation

Low-flow scour

$Z_{low-flow}$ = 1 ft. of scour (The spillway flows only during the PMF, so 1.0 ft was assumed to be conservative)

Local Scour at Stilling Basin

Zimmerman and Maniak equation for local scour below a stilling basin

$$d_s = K\left(\frac{q^{0.82}}{D_{85}^{0.23}}\right)\left(\frac{d_m}{q^{0.67}}\right)^{0.93} - d_m$$

d_s = Depth of Scour below streambed, ft
K = 1.95 inch-pound units
q = Design discharge per unit width, $ft^3/s/ft$
D_{85} = Particle size for which 85 percent is finer than, mm 0.2
d_m = Downstream mean water depth, ft

Input Data and Scour Calculation

Input Data: (Output from Flowmaster)

Discharge q, 100yr	Channel Velocity, V_m	Maximum Depth, Y_{max}	Flow Area	Top Width	Hydraulic Depth, Y_h	Energy Slope, S_e	Froude Number	Bend Angle α	Manning's Roughness, n	Blench's zero bed factor
cfs/ft	ft/s	ft	sf	ft	ft	ft/ft		degrees		ft/s^2
6.46	6.56	0.98	985	1,005	0.98	0.0125	1.17	0	0.025	0.40

(*Comments: Straight channel; hence input bend angle is zero)

Scour Calculation:

$Z_{general}$	Z_{local}	Z_{bend}*	$Z_{bedform}$	$Z_{low-flow}$	F.S.	Total Channel Scour, Zt	Local Scour Depth at Basin	Total Scour at Basin Toe
ft	ft	ft	ft	ft		ft	ft	ft
2.84	0.00	0.00	0.59	1.0	1	4.43	3.02	7.5

24hr General Storm Spillway Hydraulics

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.025	
Channel Slope	1.25000	%
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	1000.00	ft
Discharge	20983.00	ft³/s

Results

Normal Depth	1.99	ft
Flow Area	2002.26	ft²
Wetted Perimeter	1010.73	ft
Top Width	1009.96	ft
Critical Depth	2.39	ft
Critical Slope	0.00684	ft/ft
Velocity	10.48	ft/s
Velocity Head	1.71	ft
Specific Energy	3.70	ft
Froude Number	1.31	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.99	ft
Critical Depth	2.39	ft
Channel Slope	0.01250	ft/ft
Critical Slope	0.00684	ft/ft

White Tanks FRS No. 3
Downstream Channel Scour Calculation

Calculation of Scour Depth for 24hr-General Storm
(Calculations are based on Maricopa County Hydraulic Design Manual)

Channel: White Tanks DS Channel (S = 1.25%)

Location: Emergency Spillway Channel Bank and Spillway Structure

Total Scour, $$Z_t = FS\left(Z_{long-term} + Z_{general} + Z_{local} + Z_{bend} + Z_{bedform} + Z_{low-flow}\right)$$

Where,

FS = Factor of Safety (with the most commonly used value of 1.3)
$Z_{long-term}$ = Long-term scour
$Z_{general}$ = General scour
Z_{local} = Local scour
Z_{bend} = Bend scour
$Z_{bedform}$ = Bedform scour
$Z_{low-flow}$ = Low-flow scour

Equations for each scour component:

Long-Term Scour

$Z_{long-term}$ = N/A long-term scour not applicable because the spillway flows only during the PMF

General scour

$$Z_{general} = \boxed{d_{fo} = \frac{q_f^{\frac{2}{3}}}{F_{bo}^{\frac{1}{3}}},\ d_s = Zd_{fo}}$$ Blench Equation

Where,
d_{fo} = Depth for zero bed sediment transport, ft
q_f = Design flood discharge per unit width, ft³/s/ft
F_{bo} = Blench's "zero bed factor" in ft/s² (see attached graph) D_{50}= 0.44
d_s = Depth of scour, ft
Z = Multiplying factor for Blench regime, 0.6

Local scour

Z_{local} = N/A (scour for bridge/culvert, calculated separately where appropriate)

Bend scour

$$Z_{bend} = \boxed{Y_{max}\frac{0.0685V_m^{0.8}}{Y_h^{0.4}S_e^{0.3}}\left(2.1\left[\frac{\sin^2(\alpha/2)}{\cos\alpha}\right]^{0.2}\right)-1}$$

Where,
α = Angle between point of curvature and channel centerline
Z_{bend} = 0, when α ≤17.8

Bedform scour

$$Z_{bedform} = \boxed{0.5d_h}$$

$$\boxed{d_h = 0.066\ Y_h^{1.21}}$$ (for dune height calculation) Fr<0.7

$$\boxed{d_h = 0.28\pi Y_h\ Fr^2}$$ (for antidune height calculation) Fr>0.7

Where,
d_h = Dune or Antidune height, ft
Y_h = Hydraulic depth, ft
V = Channel average velocity, ft/s
Fr = Froude #

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White Tanks FRS No. 3
Downstream Channel Scour Calculation

Low-flow scour

$Z_{low\text{-}flow}$ = 1 ft. of scour (The spillway flows only during the PMF, so 1.0 ft was assumed to be conservative)

Local Scour at Stilling Basin

Zimmerman and Maniak equation for local scour below a stilling basin

$$d_s = \left[K \left(\frac{q^{0.82}}{D_{85}^{0.23}} \right) \left(\frac{d_m}{q^{0.67}} \right)^{0.93} - d_m \right]$$

d_s = Depth of Scour below streambed, ft
K = 1.95 inch-pound units
q = Design discharge per unit width, $ft^3/s/ft$
D_{85} = Particle size for which 85 percent is finer than, mm 5.58
d_m = Downstream mean water depth, ft

Input Data and Scour Calculation

Input Data: (Output from Flowmaster)

Discharge q, 100yr	Channel Velocity, V_m	Maximum Depth, Y_{max}	Flow Area	Top Width	Hydraulic Depth, Y_h	Energy Slope, S_e	Froude Number	Bend Angle α	Manning's Roughness, n	Blench's zero bed factor
cfs/ft	ft/s	ft	sf	ft	ft	ft/ft		degrees		ft/s^2
20.98	10.48	1.99	2.002	1.011	1.98	0.0125	1.31	0	0.025	1.31

(*Comments: Straight channel; hence input bend angle is zero)

Scour Calculation:

$Z_{general}$	Z_{local}	Z_{bend}*	$Z_{bedform}$	$Z_{low\text{-}flow}$	F.S.	Total Channel Scour, Zt	Local Scour Depth at Basin	Total Scour at Basin Toe
ft	ft	ft	ft	ft		ft	ft	ft
4.21	0.00	0.00	1.49	1.0	1.3	8.72	2.54	11.3

White Tanks FRS No. 3
Downstream Channel Scour Calculation

Calculation of Scour Depth for 24hr-General Storm
(Calculations are based on Maricopa County Hydraulic Design Manual)

Channel: White Tanks DS Channel (S = 1.25%)

Location: Emergency Spillway Channel Bank and Spillway Structure

Total Scour, $$Z_t = FS\left(Z_{long-term} + Z_{general} + Z_{local} + Z_{bend} + Z_{bedform} + Z_{low-flow}\right)$$

Where,
FS = Factor of Safety (with the most commonly used value of 1.3)
$Z_{long\text{-}term}$ = Long-term scour
$Z_{general}$ = General scour
Z_{local} = Local scour
Z_{bend} = Bend scour
$Z_{bedform}$ = Bedform scour
$Z_{low\text{-}flow}$ = Low-flow scour

Equations for each scour component:

Long-Term Scour

$Z_{long\text{-}term}$ = N/A long-term scour not applicable because the spillway flows only during the PMF

General scour

$$Z_{general} = \left[d_{fo} = \frac{q_f^{\frac{2}{3}}}{F_{bo}^{\frac{1}{3}}},\ d_s = Z d_{fo} \right]$$ Blench Equation

Where,
d_{fo} = Depth for zero bed sediment transport, ft
q_f = Design flood discharge per unit width, $ft^3/s/ft$
F_{bo} = Blench's "zero bed factor" in ft/s^2 (see attached graph) D_{50}= 0.04
d_s = Depth of scour, ft
Z = Multiplying factor for Blench regime, 0.6

Local scour

Z_{local} = N/A (scour for bridge/culvert, calculated separately where appropriate)

Bend scour

$$Z_{bend} = \left[Y_{max} \frac{0.0685 V_m^{0.8}}{Y_h^{0.4} S_e^{0.3}} \left(2.1 \left[\frac{\sin^2(\alpha/2)}{\cos\alpha} \right]^{0.2} \right) - 1 \right]$$

Where,
α = Angle between point of curvature and channel centerline
Z_{bend} = 0, when α ≤17.8

Bedform scour

$$Z_{bedform} = \left[0.5 d_h \right]$$

$$\left[d_h = 0.066\ Y_h^{1.21} \right]$$ (for dune height calculation) Fr<0.7

$$\left[d_h = 0.28 \pi Y_h\ Fr^2 \right]$$ (for antidune height calculation) Fr>0.7

Where,
d_h = Dune or Antidune height, ft
Y_h = Hydraulic depth, ft
V = Channel average velocity, ft/s
Fr = Froude #

White Tanks FRS No. 3
Downstream Channel Scour Calculation

Low-flow scour

$Z_{low\text{-}flow}$ = 1 ft. of scour (The spillway flows only during the PMF, so 1.0 ft was assumed to be conservative)

Local Scour at Stilling Basin

Zimmerman and Maniak equation for local scour below a stilling basin

$$d_s = \boxed{K\left(\frac{q^{0.82}}{D_{85}^{0.23}}\right)\left(\frac{d_m}{q^{0.67}}\right)^{0.93} - d_m}$$

d_s = Depth of Scour below streambed, ft
K = 1.95 inch-pound units
q = Design discharge per unit width, $ft^3/s/ft$
D_{85} = Particle size for which 85 percent is finer than, mm 0.2
d_m = Downstream mean water depth, ft

Input Data and Scour Calculation

Input Data: (Output from Flowmaster)

Discharge q, 100yr	Channel Velocity, V_m	Maximum Depth, Y_{max}	Flow Area	Top Width	Hydraulic Depth, Y_h	Energy Slope, S_e	Froude Number	Bend Angle α	Manning's Roughness, n	Blench's zero bed factor
cfs/ft	ft/s	ft	sf	ft	ft	ft/ft		degrees		ft/s^2
20.98	10.48	1.99	2,002	1,011	1.98	0.0125	1.31	0	0.025	0.40

(*Comments: Straight channel; hence input bend angle is zero)

Scour Calculation:

$Z_{general}$	Z_{local}	Z_{bend*}	$Z_{bedform}$	$Z_{low\text{-}flow}$	F.S.	Total Channel Scour, Zt	Local Scour Depth at Basin	Total Scour at Basin Toe
ft	ft	ft	ft	ft		ft	ft	ft
6.26	0.00	0.00	1.49	1.0	1	8.75	7.76	16.5

6hr Local Storm Spillway Hydraulics

Project Description

Friction Method	Manning Formula	
Solve For	Normal Depth	

Input Data

Roughness Coefficient	0.025	
Channel Slope	1.25000	%
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	1000.00	ft
Discharge	26838.00	ft^3/s

Results

Normal Depth	2.31	ft
Flow Area	2321.94	ft^2
Wetted Perimeter	1012.43	ft
Top Width	1011.54	ft
Critical Depth	2.81	ft
Critical Slope	0.00648	ft/ft
Velocity	11.56	ft/s
Velocity Head	2.08	ft
Specific Energy	4.38	ft
Froude Number	1.34	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.31	ft
Critical Depth	2.81	ft
Channel Slope	0.01250	ft/ft
Critical Slope	0.00648	ft/ft

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5/6/2010 5:30:21 PM 27 Siemons Company Drive Suite 200 W Watertown, CT 06795 USA +1-203-755-1666 Page 1 of 2

P:\WRES\FCDMC\23445608_White Tanks_Phase 2 Construction\Downstream Channel Design Review\Scour Calculation\Scour Calc.xls 8

White Tanks FRS No. 3
Downstream Channel Scour Calculation

Calculation of Scour Depth for 6hr-Local Storm

(Calculations are based on Maricopa County Hydraulic Design Manual)

Channel: White Tanks DS Channel (S = 1.25%)

Location: Emergency Spillway Channel Bank and Spillway Structure

Total Scour,

$$Z_t = FS\left(Z_{long-term} + Z_{general} + Z_{local} + Z_{bend} + Z_{bedform} + Z_{low-flow}\right)$$

Where,

FS = Factor of Safety (with the most commonly used value of 1.3)
$Z_{long-term}$ = Long-term scour
$Z_{general}$ = General scour
Z_{local} = Local scour
Z_{bend} = Bend scour
$Z_{bedform}$ = Bedform scour
$Z_{low-flow}$ = Low-flow scour

Equations for each scour component:

Long-Term Scour

$Z_{long-term}$ = N/A long-term scour not applicable because the spillway flows only during the PMF

General scour

$$Z_{general} = \left[d_{fo} = \frac{q_f^{\frac{2}{3}}}{F_{bo}^{\frac{1}{3}}},\ d_s = Z d_{fo} \right]$$

Blench Equation

Where,
d_{fo} = Depth for zero bed sediment transport, ft
q_f = Design flood discharge per unit width, $ft^3/s/ft$
F_{bo} = Blench's "zero bed factor" in ft/s^2 (see attached graph) D_{50}= 0.44
d_s = Depth of scour, ft
Z = Multiplying factor for Blench regime, 0.6

Local scour

Z_{local} = N/A (scour for bridge/culvert, calculated separately where appropriate)

Bend scour

$$Z_{bend} = \left[Y_{max} \frac{0.0685 V_m^{0.8}}{Y_h^{0.4} S_e^{0.3}} \left(2.1 \left[\frac{\sin^2(\alpha/2)}{\cos\alpha} \right]^{-0.2} \right) - 1 \right]$$

Where,
α = Angle between point of curvature and channel centerline
Z_{bend} = 0, when $\alpha \leq 17.8$

Bedform scour

$$Z_{bedform} = \boxed{0.5 d_h}$$

$$\boxed{d_h = 0.066\ Y_h^{1.21}}$$ (for dune height calculation) Fr<0.7

$$\boxed{d_h = 0.28 \pi Y_h Fr^2}$$ (for antidune height calculation) Fr>0.7

Where,
d_h = Dune or Antidune height, ft
Y_h = Hydraulic depth, ft
V = Channel average velocity, ft/s
Fr = Froude #

White Tanks FRS No. 3
Downstream Channel Scour Calculation

Low-flow scour

$Z_{low-flow}$ = 1 ft. of scour (The spillway flows only during the PMF, so 1.0 ft was assumed to be conservative)

Local Scour at Stilling Basin

Zimmerman and Maniak equation for local scour below a stilling basin

$$d_s = \left[K \left(\frac{q^{0.82}}{D_{85}^{0.23}} \right) \left(\frac{d_m}{q^{0.67}} \right)^{0.93} - d_m \right]$$

d_s = Depth of Scour below streambed, ft
K = 1.95 inch-pound units
q = Design discharge per unit width, $ft^3/s/ft$
D_{85} = Particle size for which 85 percent is finer than, mm 5.58
d_m = Downstream mean water depth, ft

Input Data and Scour Calculation

Input Data: (Output from Flowmaster)

Discharge q, 100yr	Channel Velocity, V_m	Maximum Depth, Y_{max}	Flow Area	Top Width	Hydraulic Depth, Y_h	Energy Slope, S_e	Froude Number	Bend Angle α	Manning's Roughness, n	Blench's zero bed factor
cfs/ft	ft/s	ft	sf	ft	ft	ft/ft		degrees		ft/s^2
26.84	11.56	2.31	2.322	1.012	2.30	0.0125	1.34	0	0.025	1.31

(*Comments: Straight channel; hence input bend angle is zero)

Scour Calculation:

$Z_{general}$	Z_{local}	Z_{bend}*	$Z_{bedform}$	$Z_{low-flow}$	F.S.	Total Channel Scour, Zt	Local Scour Depth at Basin	Total Scour at Basin Toe
ft	ft	ft	ft	ft		ft	ft	ft
4.97	0.00	0.00	1.81	1.0	1.3	10.12	3.16	13.3

White Tanks FRS No. 3
Downstream Channel Scour Calculation

Calculation of Scour Depth for 6hr-Local Storm
(Calculations are based on Maricopa County Hydraulic Design Manual)

Channel: White Tanks DS Channel (S = 1.25%)

Location: Emergency Spillway Channel Bank and Spillway Structure

Total Scour, $Z_t = FS\left(Z_{long-term} + Z_{general} + Z_{local} + Z_{bend} + Z_{bedform} + Z_{low-flow}\right)$

Where,

FS = Factor of Safety (with the most commonly used value of 1.3)
$Z_{long-term}$ = Long-term scour
$Z_{general}$ = General scour
Z_{local} = Local scour
Z_{bend} = Bend scour
$Z_{bedform}$ = Bedform scour
$Z_{low-flow}$ = Low-flow scour

Equations for each scour component:

Long-Term Scour

$Z_{long-term}$ = N/A long-term scour not applicable because the spillway flows only during the PMF

General scour

$Z_{general} = d_{fo} = \dfrac{q_f^{\frac{2}{3}}}{F_{bo}^{\frac{1}{3}}},\ d_s = Zd_{fo}$ Blench Equation

Where,
d_{fo} = Depth for zero bed sediment transport, ft
q_f = Design flood discharge per unit width, $ft^3/s/ft$
F_{bo} = Blench's "zero bed factor" in ft/s^2 (see attached graph) D_{50}= 0.04
d_s = Depth of scour, ft
Z = Multiplying factor for Blench regime, 0.6

Local scour

Z_{local} = N/A (scour for bridge/culvert, calculated separately where appropriate)

Bend scour

$$Z_{bend} = Y_{max}\frac{0.0685V_m^{0.8}}{Y_h^{0.4}S_e^{0.3}}\left(2.1\left[\frac{\sin^2(\alpha/2)}{\cos\alpha}\right]^{0.2}\right) - 1$$

Where,
α = Angle between point of curvature and channel centerline
Z_{bend} = 0, when α ≤17.8

Bedform scour

$Z_{bedform} = 0.5d_h$

$d_h = 0.066\ Y_h^{1.21}$ (for dune height calculation) Fr<0.7

$d_h = 0.28\pi Y_h Fr^2$ (for antidune height calculation) Fr>0.7

Where,
d_h = Dune or Antidune height, ft
Y_h = Hydraulic depth, ft
V = Channel average velocity, ft/s
Fr = Froude #

White Tanks FRS No. 3
Downstream Channel Scour Calculation

Low-flow scour

$Z_{low-flow}$ = 1 ft. of scour (The spillway flows only during the PMF, so 1.0 ft was assumed to be conservative)

Local Scour at Stilling Basin

Zimmerman and Maniak equation for local scour below a stilling basin

$$d_s = K\left(\frac{q^{0.82}}{D_{85}^{0.23}}\right)\left(\frac{d_m}{q^{0.67}}\right)^{0.93} - d_m$$

d_s = Depth of Scour below streambed, ft
K = 1.95 inch-pound units
q = Design discharge per unit width, $ft^3/s/ft$
D_{85} = Particle size for which 85 percent is finer than, mm 0.2
d_m = Downstream mean water depth, ft

Input Data and Scour Calculation

Input Data: (Output from Flowmaster)

Discharge q, 100yr	Channel Velocity, V_m	Maximum Depth, Y_{max}	Flow Area	Top Width	Hydraulic Depth, Y_h	Energy Slope, S_e	Froude Number	Bend Angle α	Manning's Roughness, n	Blench's zero bed factor
cfs/ft	ft/s	ft	sf	ft	ft	ft/ft		degrees		ft/s^2
26.84	1.56	2.31	2,322	1,012	2.30	0.0125	1.34	0	0.025	0.40

(*Comments: Straight channel; hence input bend angle is zero)

Scour Calculation:

$Z_{general}$	Z_{local}	Z_{bend}*	$Z_{bedform}$	$Z_{low-flow}$	F.S.	Total Channel Scour, Zt	Local Scour Depth at Basin	Total Scour at Basin Toe
ft	ft	ft	ft	ft		ft	ft	ft
7.38	0.00	0.00	1.81	1.0	1	10.19	9.45	19.6

APPENDIX E – STEPPED SPILLWAY DESIGN

WT03
Stepped Spillway Design

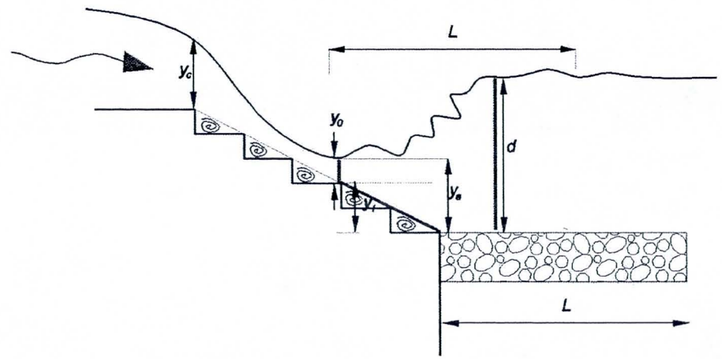
Note: The flow over stepped spillway could be nappe flow or skimming flow depending on the discharge and spillway dimension. The skimming flow occurs for large discharges and the nappe flow occurs for low discharges. In this design for the 100-year event, the skimming flow was assumed. $h/l = 0.5$ and $y_c/h > 1$. $C_f = 0.18$ (Rajaranam, 1990) was used to estimate the flow depth at stepped spillways. $y_0 = (0.5*C_f*q^2/SIN(ATAN((h/l))/g)^{1/3}$, assuming the uniform flow depth attained at the toe of spillways.

Reference:

Carlos Gonzalez and Hubert Chanson, Hydraulic Design of Stepped Spillways and Downstream Energy Dissipators for Embankment Dams, Dam Engineering, Vol. 17, No. 4, 2007

N Rajaratnam, Skimming Flow in Stepped Spillways, Journal of Hydraulic Engineering, Vol. 116, No. 4, 1990

Robert Boes and Willi Hager, Hydraulic Design of Stepped Spillways, Journal of Hydraulic Engineering, Vol. 129, No. 9, 2003



Note: $Fr_0 = V_0/(g*y_0)^{0.5} = C_f^{-0.5} = 2.4$, and $L/y_0 = 14$, as read from Figure 6.5 in the HEC-14, Hydraulic Design of Energy Dissipators for Culverts and Channels (FHWA, 2006). Since $y_2<d$, hydraulic jumps occur at steps. A momentum equation was derived to identify the location of potential hydraulic jumps. The equation (see below) reflects the momentum balance between two boundary section (see the figure). An assumption was made that the uniform flow depth would be developed before hydraulic jumps. The downstream flow depths were from the HEC-RAS model (mixed flow regime).

The momentum equation:

$$\frac{QV_0}{g} + w(y_0 + y_1)\frac{(y_0 + y_1)}{2} = \frac{QV_d}{g} + wd\frac{d}{2}$$

$$y_1 = \sqrt{\frac{2Q(V_d - V_0)}{wg} + d^2} - y_0$$

Assume flow depth at the stilling basin upstream

$$y_a = y_1 + y_0$$

Other equations:

$$V_0 = \frac{Q}{wy_0} \qquad V_a = \frac{Q}{wy_a} \qquad V_d = \frac{Q}{wd}$$

ID	Q100 (cfs)	Crest Width, w (ft)	Critical Depth, y_c (ft)	Step Height, h (ft)	Step Length, l (ft)	y_c/h	Uniform Flow Depth, y_0 (ft)	V_0 (fps)	Fr_0	y_1	Stilling Basin Upstream Min. Depth, y_a (ft)	Stilling Basin Upstream Velocity, V_a (fps)	Stilling Basin Downstream Flow Depth, d (ft)	Stilling Basin Downstream Velocity, V_d (fps)	Stilling Basin Length*, L (ft)
9, 10	328.8	50	1.10	1	2	1.10	0.65	10.2	2.2	3.3	4.0	1.7	4.4	1.5	9
8	309.6	40	1.23	1	2	1.23	0.72	10.7	2.2	3.2	3.9	2.0	4.4	1.8	10
5	96.3	15	1.08	1	2	1.08	0.64	10.1	2.2	4.0	4.6	1.4	5	1.3	9
4	260.6	30	1.32	1	2	1.32	0.78	11.2	2.2	3.7	4.5	1.9	5	1.7	11
3	216.3	30	1.17	1	2	1.17	0.69	10.5	2.2	3.9	4.6	1.6	5	1.4	10
2	63.6	10	1.08	1	2	1.08	0.63	10.1	2.2	4.0	4.6	1.4	5	1.3	9
1	386.3	30	1.72	1	2	1.72	1.01	12.7	2.2	3.1	4.1	3.1	5	2.6	14

Junction Structure

ID	Q100 (cfs)	Crest Width, w (ft)	Critical Depth, y_c (ft)	Step Height, h (ft)	Step Length, l (ft)	y_c/h	Uniform Flow Depth, y_0 (ft)	V_0 (fps)	Fr_0	y_1	Stilling Basin Upstream Min. Depth, y_a (ft)	Stilling Basin Upstream Velocity, V_a (fps)	Stilling Basin Downstream Flow Depth, d (ft)	Stilling Basin Downstream Velocity, V_d (fps)	Stilling Basin Length*, L (ft)
7	300	25	1.64	1	2	1.64	0.97	12.4	3.1	2.5	3.5	3.4	4.4	2.7	14
6	240	20	1.64	1	2	1.64	0.97	12.4	3.1	2.5	3.5	3.4	4.4	2.7	14

APPENDIX F – RIPRAP SIZING, CUT-OFF WALL AND SEEPAGE ANALYSIS

WT03
Riprap Sizing

Reference: River Mechanics Manual for DDMSW (draft), FCDMC, Sep 2009 and HEC-14 (FHWA, 2006)

Downstream of Aprons of Grade Control Structures/Culverts

$$D_{50} = 0.0372 V^2 \left(\frac{\gamma_W}{\gamma_S - \gamma_W} \right)$$ (DDMS50)

Average velocity, V=	4.2	fps	*(Range from 2.7 to 4.2 fps, see HEC-RAS model mixed flow analysis)*
Specific weight of water, γ_W=	62.4	lb/ft^3	
Specific weight of riprap, γ_S=	165	lb/ft^3	
Riprap mean size, D50=	0.40	ft	
Design riprap size, D50 =	**0.75**	**ft**	

Riprap within Stepped Spillway Stilling Basin

$$D_{50} = 0.0372 V^2 \left(\frac{\gamma_W}{\gamma_S - \gamma_W} \right)$$ (DDMS50)

Average velocity, V=	3.4	fps	*(Range from 1.4 to 3.4 fps, see the stepped spillway design sheet)*
Specific weight of water, γ_W=	62.4	lb/ft^3	
Specific weight of riprap, γ_S=	165	lb/ft^3	
Riprap mean size, D50=	0.26	ft	
Design riprap size, D50 =	**1.5**	**ft**	

Downstream of Stepped Spillway Stilling Basin

$$D_{50} = 0.0126 V^2$$ (DDMS51)

Average velocity, V=	2.7	fps	*(Range from 1.3 to 2.7 fps, see the stepped spillway design sheet)*
Riprap mean size, D50=	0.09	ft	
Design riprap size, D50 =	**0.75**	**ft**	

Upstream/Downstream of Pipe Crossing at the Emergency Spillway

$$D_{50} = 0.0191 V_a^2 \left(\frac{\gamma_W}{\gamma_S - \gamma_W} \right)$$ (DDMSW48)

Average velocity, Va=	11.6	fps
Specific weight of water, γ_W=	62.4	lb/ft^3
Specific weight of riprap, γ_S=	165	lb/ft^3
Riprap mean size, D50=	1.56	ft
Design riprap size, D50 =	**1.67**	**ft**

Riprap at Storm Drain Oulet, System 4 ,6 ,8, 11 and 13

The storm drains collect runoff from half street of about 1000 ft long. Assuming a ROW of 70 feet, a 100-year runoff coefficient of 0.8, and a peak rainfall intensity of 6 in/hr, the 100-year peak flow from the half street will be 10 cfs. Assuming the tail water depth within the channel as two foot.

$$D_{50} = 0.2D \left(\frac{Q}{\sqrt{g} D^{2.5}} \right)^{4/3} \left(\frac{D}{TW} \right)$$

100-year peak flow, Q=	10	cfs
Culvert diameter, D=	1.5	ft
Tailwater, TW=	2	ft
Gravity acceleration, g=	32.2	ft/s2
Riprap mean size, D50=	0.12	ft
Design riprap size, D50 =	**0.75**	**ft**

Riprap at Storm Drain Oulet, System 12

During the 100-year event, a peak flow of 256 cfs will be diverted through System 12 - (2) 48" pipe. The normal depth of 256 cfs at Reach 6 is 2.5 feet. Given that more than 256 cfs will be flowing within the channel, a tail water depth of 3 feet is assumed.

$$D_{50} = 0.2D \left(\frac{Q}{\sqrt{g} D^{2.5}} \right)^{4/3} \left(\frac{D}{TW} \right)$$

100-year peak flow, Q=	128	cfs
Culvert diameter, D=	4	ft
Tailwater, TW=	3	ft
Gravity acceleration, g=	32.2	ft/s2
Riprap mean size, D50=	0.67	ft
Design riprap size, D50 =	**0.75**	**ft**

Riprap at Storm Drain Oulet, System 14

During the 100-year event, a peak flow of 166 cfs will be conveyed through System 14 - (2) 49"X33" pipe. The equivalent diameter of the pipe is 3.3 feet. A tail water depth of 3 feet is assumed.

$$D_{50} = 0.2D\left(\frac{Q}{\sqrt{g}D^{2.5}}\right)^{4/3}\left(\frac{D}{TW}\right)$$

100-year peak flow, Q=	83	cfs
Culvert diameter, D=	3.3	ft
Tailwater, TW=	3	ft
Gravity acceleration, g=	32.2	ft/s2
Riprap mean size, D50=	0.49	ft
Design riprap size, D50 =	**0.75**	**ft**

Riprap at Storm Drain Oulet, System 15

During the 100-year event, a peak flow of 55 cfs will be conveyed through System 15 - (2) 24" pipe. A tail water depth of 3 feet is assumed.

$$D_{50} = 0.2D\left(\frac{Q}{\sqrt{g}D^{2.5}}\right)^{4/3}\left(\frac{D}{TW}\right)$$

100-year peak flow, Q=	27.5	cfs
Culvert diameter, D=	2	ft
Tailwater, TW=	3	ft
Gravity acceleration, g=	32.2	ft/s2
Riprap mean size, D50=	0.22	ft
Design riprap size, D50 =	**0.75**	**ft**

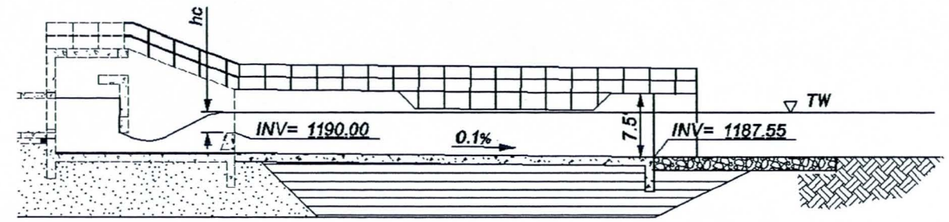
Riprap at Storm Drain Oulet, System 16 and 17 (STA 327+65, STA 342+10)

Per Rational Method calculations, the 100-year peak flow for SF01 is 150 cfs. It is assumed that the peak flow is eqally distributed to four 18-in pipes. A 2-feet tailwater depth is assumed.

$$D_{50} = 0.2D\left(\frac{Q}{\sqrt{g}D^{2.5}}\right)^{4/3}\left(\frac{D}{TW}\right)$$

100-year peak flow, Q=	37.5	cfs
Culvert diameter, D=	1.5	ft
Tailwater, TW=	2	ft
Gravity acceleration, g=	32.2	ft/s2
Riprap mean size, D50=	0.72	ft
Design riprap size, D50 =	**0.75**	**ft**

Riprap at Principal Spillway Extension Outlet



The water surface elevation is controled by downstream backwater, and the tail water depth is 5.3 feet.

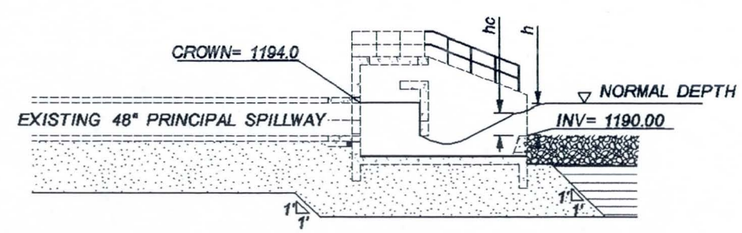
$$D_{50} = 0.0372V^2\left(\frac{\gamma_W}{\gamma_S - \gamma_W}\right) \quad \text{(DDMS50)}$$

PMF peak flow, Q=	285	cfs		
Sill width, w=	15	ft		
Critical Depth, hc=	1.8	ft		
			< 1192.9	
WSEL at the sill=	1191.8	ft	ft	(HEC-RAS output)

Therefore, it is the backwater controls the water surface elevation at the extrension structure outlet.

Flow area at the outlet, A=	127	sq ft
Average velocity, Va= Q/A=	2.2	fps
Specific weight of water, γ_W=	62.4	lb/ft^3
Specific weight of riprap, γ_S=	165	lb/ft^3
Riprap mean size, D50=	0.11	ft
Design riprap size, D50 =	**1.50**	**ft**

Riprap at Principal Spillway Wasteway Outlet



The normal depth of wasteway channel is higher than the critical depth at the sill. Therefore, it is the normal depth controls the water surface elevation.

$$D_{50} = 0.0372V^2\left(\frac{\gamma_W}{\gamma_S - \gamma_W}\right) \quad \text{(DDMS50)}$$

Design peak flow, Q=	221	cfs

Sill width, w=	15	ft		
Critical Depth, hc=	1.5	ft		
Normal Depth, h=	2.5	ft	(See Appendix H.4)	Controls WSEL
Average velocity, Va=	4.4	fps	(See Appendix H.4)	
Specific weight of water, γ_w=	62.4	lb/ft^3		
Specific weight of riprap, γ_s=	165	lb/ft^3		
Riprap mean size, D50=	0.44	ft		
Design riprap size, D50 =	**1.50**	**ft**		

Riprap at Silt Basin (Sta 244+00)

$$D_{50} = 0.4623 q^{0.529} S^{0.307}$$

(DDMS54)

100-year peak flow Q=	556	cfs
Flow width, B=	90	ft
Unit discharge, q=	6.18	cfs/ft
Slope (6H:1V), S=	0.17	ft/ft
Riprap mean size, D50=	0.70	ft
Design riprap size, D50 =	**1.50**	**ft**

WT30
Cut-Off Wall

16'X7' CBC Apron Cut-Off Wall

Note: Equation DDMS34 in the River Mechanics Manual for DDMSW (draft), FCDMC, Sep 2009 was used to estimate scour depth downstream of culvert aprons

$$h = K\left(\frac{q^{0.82}}{D_{85}^{0.23}}\right)\left(\frac{y_m}{q^{2/3}}\right)^{0.93} - y_m$$

K=	1.95
Discharge, Q=	800cfs
Downstrean Flow Depth, h=	5.6ft
Downstream Channel Bottom, w1=	30ft
Downstream Channel Top Width, w2=	74.8ft
Discharge per Unit Length, q=	10.70cfs/ft
Flow Area, A=	293.44ft^2
Hydraulic Depth at Outlet, y_m=	3.92ft
D85 =	4mm
Scour Depth, h=	4.19ft

Design

Upstream Cut-Off Wall, h1=	**4ft**
Downstream Cut-Off Wall, h2=	**6ft**

Drop Structure Apron Cut-Off Wall

Note: Equation DDMS34 in the River Mechanics Manual for DDMSW (draft), FCDMC, Sep 2009 was used to estimate scour depth downstream of drop structure concrete apron.

$$h = K\left(\frac{q^{0.82}}{D_{85}^{0.23}}\right)\left(\frac{y_m}{q^{2/3}}\right)^{0.93} - y_m$$

K=	1.95
Discharge, Q=	800cfs
Downstrean Flow Depth, h=	5.6ft
Downstream Channel Bottom, w1=	30ft
Downstream Channel Top Width, w2=	74.8ft
Discharge per Unit Length, q=	10.70cfs/ft
Flow Area, A=	293.44ft^2
Hydraulic Depth at Outlet, y_m=	3.92ft
D85 =	4mm
Scour Depth, h=	4.19ft

Design

Upstream Cut-Off Wall, h1=	**4ft**
Downstream Cut-Off Wall, h2=	**6ft**

U Channel Downstream of Primary Outlet

Note: Equation DDMS34 in the River Mechanics Manual for DDMSW (draft), FCDMC, Sep 2009 was used to estimate scour depth downstream of Primary spillway outlet structure.

$$h = K\left(\frac{q^{0.82}}{D_{85}^{0.23}}\right)\left(\frac{y_m}{q^{2/3}}\right)^{0.93} - y_m$$

K=	1.95
Discharge, Q=	285cfs
Downstrean Flow Depth, h=	4.6ft
Downstream Channel Bottom, w1=	24ft
Downstream Channel Top Width, w2=	24ft
Discharge per Unit Length, q=	11.88cfs/ft
Flow Area, A=	110.40ft^2
Hydraulic Depth at Outlet, y_m=	4.60ft
D85 =	4mm
Scour Depth, h=	5.01ft

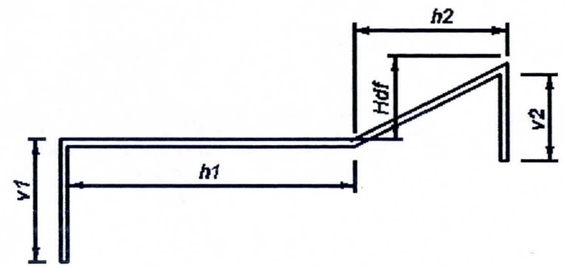
Design

Downstream Cut-Off Wall, h2=	**6ft**

WT30
Structure Seepage Analysis

Note: Lane's weighted creep method, documented in the Drainage Design Manual for Maricopa County, Arizona - Hydraulics (draft) (FCDMC, 2003), was used for structure seepage and lift force analysis. For medium sand, the weighted-creep head ratio is required to be not less than 6.0. The upstream and downstream cut-off walls are 4-foot and 6-foot deep for culverts and grade control structures, but varies for stepped spillways.

$$C_w = \frac{L_H + 3L_V}{3H_{df}}$$



See the figure,

L_H = h1+h2

L_V = 2v1+2v2+H_{df}

H_{df} = the upstream and downstream elevation difference

Grade Control Structure

For a 2-foot-drop grade control structure

h1=	26	ft
h2=	18	ft
L_H =	44	ft
L_V =	22	ft
H_{df} =	2	ft
C_w =	18	

For a 3-foot-drop grade control structure

h1=	26	ft
h2=	24	ft
L_H =	50	ft
L_V =	23	ft
H_{df} =	3	ft
C_w =	13	

For a 4-foot-drop grade control structure

h1=	26	ft
h2=	30	ft
L_H =	56	ft
L_V =	24	ft
H_{df} =	4	ft
C_w =	11	

Culvert

Culvert ID	1	2	3	4	5	6	7	8	9	10
Location	Palm Ln	Encanto Ave	Virginia Ave	Thomas	Indian School	Jackrabbit Trail	Jackrabbit Trail	Camelback Rd	Colter St	Jackrabbit Trail
L_H (ft)	100	82	80	80	158	970	212	140	62	399
L_V (ft)	21.45	22.14	23.74	23.26	22.11	26.66	25.6	23.29	20.81	20.8
H_{df} (ft)	1.45	2.14	3.74	3.26	2.11	6.7	5.6	3.29	0.81	0.8
C_w (ft)	38	23	13	15	35	53	17	21	51	192

Stepped Spillway

The elevation difference between upstream and downstream of the structure was taken as H_{df}. Each key-in has an Lv value of 3 ft.

ID	1	2	3	4	5	6	7	8	9	10
Reach	2	2	2	2	3	5	5	8	8	8
L_H (ft)	10	15	13	15	16	25	12	30	11	11
Key-in No.	1	1	1	1	1	2	1	2	1	1
U.S. Cut-off (ft)	4	6	6	6	6	11	7	4	4	4
D.S. Cut-off (ft)	6	6	6	6	8	12	8	6	6	6
L_V (ft)	26.73	32.57	32.18	32.65	37.59	63	39.5	30.7	27	27
H_{df} (ft)	3.73	5.57	5.18	5.65	6.59	11.0	6.5	4.7	4	4
C_w (ft)	8.1	6.7	7.0	6.7	6.5	6.5	6.7	8.7	7.7	7.7

APPENDIX G – DIVERSION AT LITCHFIELD HEIGHTS

WT30
Litchfield Heights Diversion

Drop inlet weir width, L=	45	ft	
Drop inlet weir elevation =	1174.1	ft	(NAVD88)
Wash flow line =	1173.1	ft	(NAVD88)

Note: The wash discharges were calculated using FlowMaster with a cross-section and wash slope obtained from the topo provided by Cooper Aerial. Weir discharges were calculated using the weir equation with c=3.0.

WSEL (ft)	Flow depth (ft)	Wash Discharge (cfs)	Weir Discharge (cfs)	Total Discharge (cfs)
1174.1	1	30.22	0	30.22
1174.3	1.2	46.94	12.07	59.01
1174.5	1.4	66.75	34.15	100.90
1174.7	1.6	93.16	62.74	155.90
1174.9	1.8	120.76	96.60	217.36
1175.1	2	166.27	135.00	301.27
1175.3	2.2	217.48	177.46	394.94
1175.5	2.4	274.36	223.63	497.99
1175.7	2.6	336.72	273.22	609.94
1175.9	2.8	404.43	326.02	730.45

The capacity of (2) 48" RGRCP pipes was calculated using the Dodson program. To pass a flow of 326 cfs, the required headwater for the culvert is 1168.0+7.86=1175.86 ft, which is slightly less than the WSEL at the wash, 1175.90 ft. Therefore, it is the drop-inlet crest that controls the flow, not the culvert.

```
                    PIPE CULVERT ANALYSIS
          COMPUTATION OF CULVERT PERFORMANCE CURVE

                       June 29, 2010

==============================================================================
                        PROGRAM INPUT DATA
DESCRIPTION                                                          VALUE
------------------------------------------------------------------------------
Culvert Diameter (ft)......................................            4.0
FHWA Chart Number..........................................             1
FHWA Scale Number (Type of Culvert Entrance)...............             2
Manning's Roughness Coefficient (n-value)..................           0.013
Entrance Loss Coefficient of Culvert Opening...............            0.5
Culvert Length (ft)........................................          190.0
Invert Elevation at Downstream end of Culvert (ft).........        1,166.7
Invert Elevation at Upstream end of Culvert (ft)...........        1,168.0
Culvert Slope (ft/ft)......................................          0.0068

Starting Flow Rate (cfs)...................................          163.0
Incremental Flow Rate (cfs)................................            0.0
Ending Flow Rate (cfs).....................................          163.0
Starting Tailwater Depth (ft)..............................            2.8
Incremental Tailwater Depth (ft)...........................            0.0
Ending Tailwater Depth (ft)................................            2.8

==============================================================================
                        COMPUTATION RESULTS

     Flow  Tailwater   Headwater (ft)       Normal  Critical  Depth at   Outlet
     Rate     Depth   Inlet     Outlet      Depth     Depth    Outlet  Velocity
    (cfs)      (ft)   Control   Control      (ft)      (ft)      (ft)     (fps)
------------------------------------------------------------------------------
    163.0       2.8      7.86      6.31       4.0      3.69       4.0     12.97

==============================================================================
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```

According to the rating curve in the table, a flow of 256 cfs will be diverted through these two 48-inch pipes from the 100-year peak flow of 556 cfs from SF14 (Appendix C.2). The remaining flow of 300 cfs will be conveyed by the existing channel.

Worksheet for Wasteway Xsection 2

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.00480	ft/ft
Left Side Slope	10.00	ft/ft (H:V)
Right Side Slope	10.00	ft/ft (H:V)
Bottom Width	14.00	ft
Discharge	221.00	ft^3/s

Results

Normal Depth	1.95	ft
Flow Area	65.46	ft^2
Wetted Perimeter	53.25	ft
Top Width	53.05	ft
Critical Depth	1.42	ft
Critical Slope	0.01827	ft/ft
Velocity	3.38	ft/s
Velocity Head	0.18	ft
Specific Energy	2.13	ft
Froude Number	0.54	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.95	ft
Critical Depth	1.42	ft
Channel Slope	0.00480	ft/ft
Critical Slope	0.01827	ft/ft

Cross Section for Wasteway Xsection 2

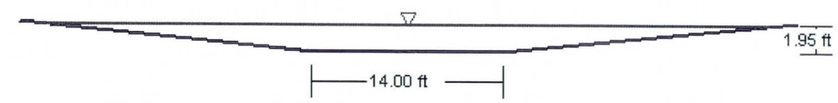
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.00480	ft/ft
Normal Depth	1.95	ft
Left Side Slope	10.00	ft/ft (H:V)
Right Side Slope	10.00	ft/ft (H:V)
Bottom Width	14.00	ft
Discharge	221.00	ft^3/s

Cross Section Image



V: 1
H: 1

Worksheet for Wasteway Xsection 2

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.00480	ft/ft
Left Side Slope	10.00	ft/ft (H:V)
Right Side Slope	10.00	ft/ft (H:V)
Bottom Width	14.00	ft
Discharge	221.00	ft^3/s

Results

Normal Depth	1.95	ft
Flow Area	65.46	ft^2
Wetted Perimeter	53.25	ft
Top Width	53.05	ft
Critical Depth	1.42	ft
Critical Slope	0.01827	ft/ft
Velocity	3.38	ft/s
Velocity Head	0.18	ft
Specific Energy	2.13	ft
Froude Number	0.54	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.95	ft
Critical Depth	1.42	ft
Channel Slope	0.00480	ft/ft
Critical Slope	0.01827	ft/ft

Cross Section for Wasteway Xsection 2

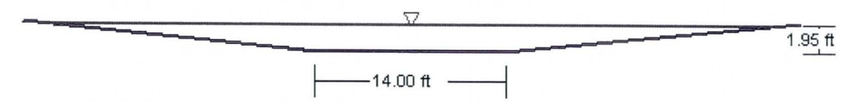
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.00480	ft/ft
Normal Depth	1.95	ft
Left Side Slope	10.00	ft/ft (H:V)
Right Side Slope	10.00	ft/ft (H:V)
Bottom Width	14.00	ft
Discharge	221.00	ft^3/s

Cross Section Image



V: 1
H: 1

H.4 WASTEWAY NORMAL DEPTH CALCULATIONS

Worksheet for Wasteway Xsection 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.00480	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	14.00	ft
Discharge	221.00	ft^3/s

Results

Normal Depth	2.48	ft
Flow Area	50.17	ft^2
Wetted Perimeter	27.37	ft
Top Width	26.41	ft
Critical Depth	1.77	ft
Critical Slope	0.01649	ft/ft
Velocity	4.40	ft/s
Velocity Head	0.30	ft
Specific Energy	2.78	ft
Froude Number	0.56	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.48	ft
Critical Depth	1.77	ft
Channel Slope	0.00480	ft/ft
Critical Slope	0.01649	ft/ft

Cross Section for Wasteway Xsection 1

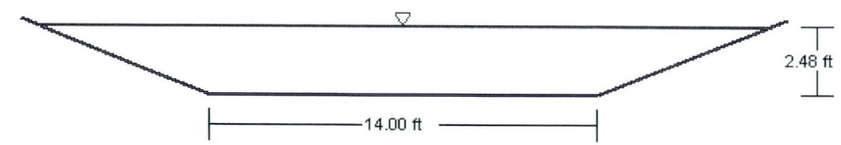
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.00480	ft/ft
Normal Depth	2.48	ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	14.00	ft
Discharge	221.00	ft^3/s

Cross Section Image



V: 1
H: 1

H.4 WASTEWAY NORMAL DEPTH CALCULATIONS

Worksheet for Wasteway Xsection 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.00480	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	14.00	ft
Discharge	221.00	ft³/s

Results

Normal Depth	2.48	ft
Flow Area	50.17	ft²
Wetted Perimeter	27.37	ft
Top Width	26.41	ft
Critical Depth	1.77	ft
Critical Slope	0.01649	ft/ft
Velocity	4.40	ft/s
Velocity Head	0.30	ft
Specific Energy	2.78	ft
Froude Number	0.56	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.48	ft
Critical Depth	1.77	ft
Channel Slope	0.00480	ft/ft
Critical Slope	0.01649	ft/ft

Cross Section for Wasteway Xsection 1

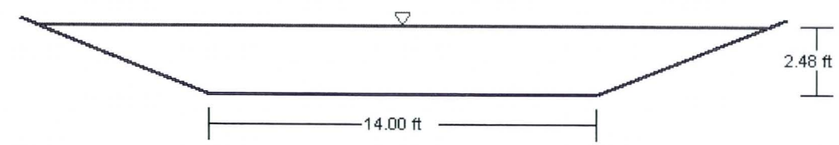
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.00480	ft/ft
Normal Depth	2.48	ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	14.00	ft
Discharge	221.00	ft³/s

Cross Section Image



V: 1
H: 1

FIGURE H.2 – HEC-RAS WORK MAP 2

FIGURE H.2 – HEC-RAS WORK MAP 2

H.3 HEC-RAS WORK MAP

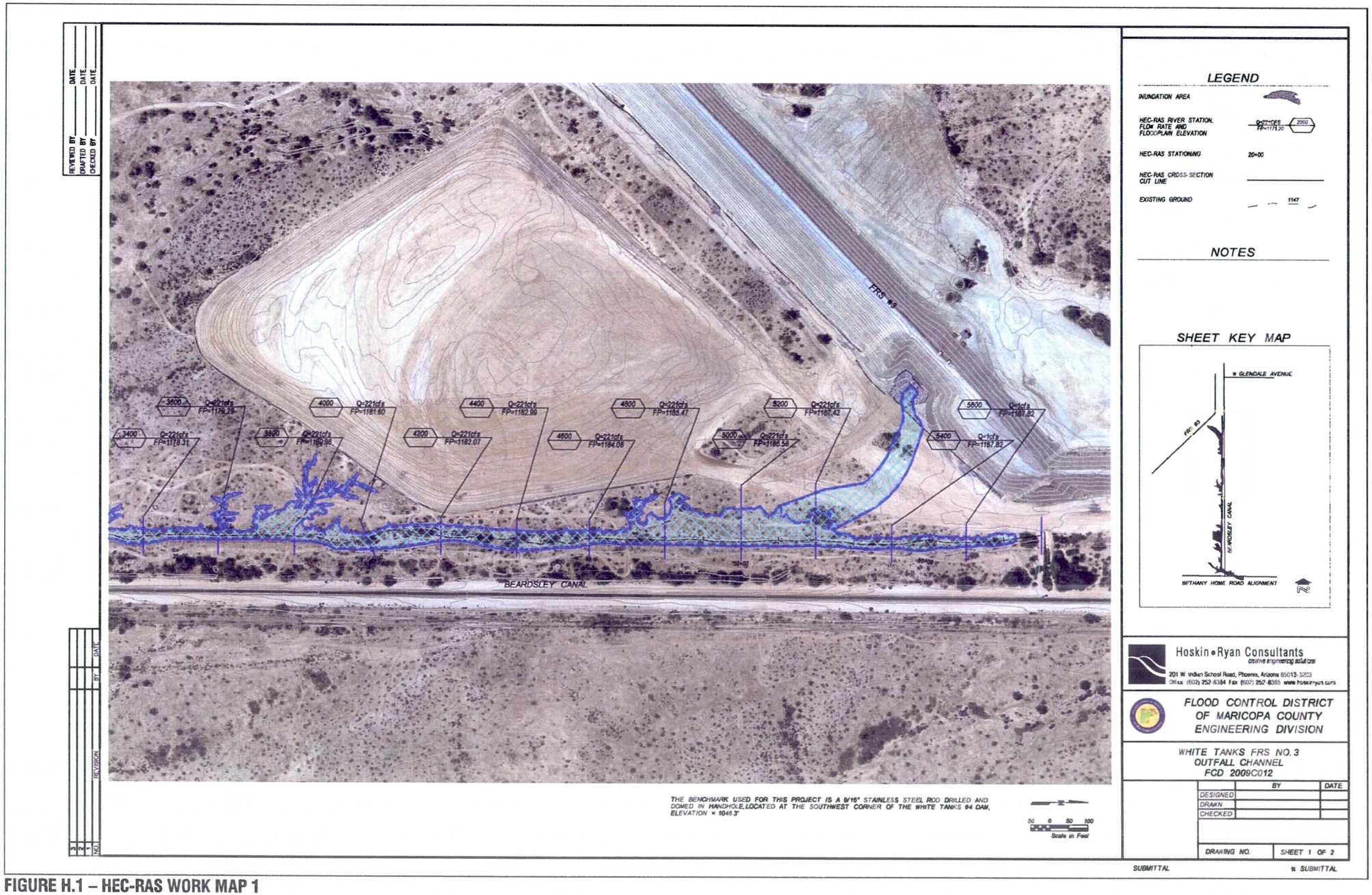


FIGURE H.1 – HEC-RAS WORK MAP 1

H.3 HEC-RAS WORK MAP

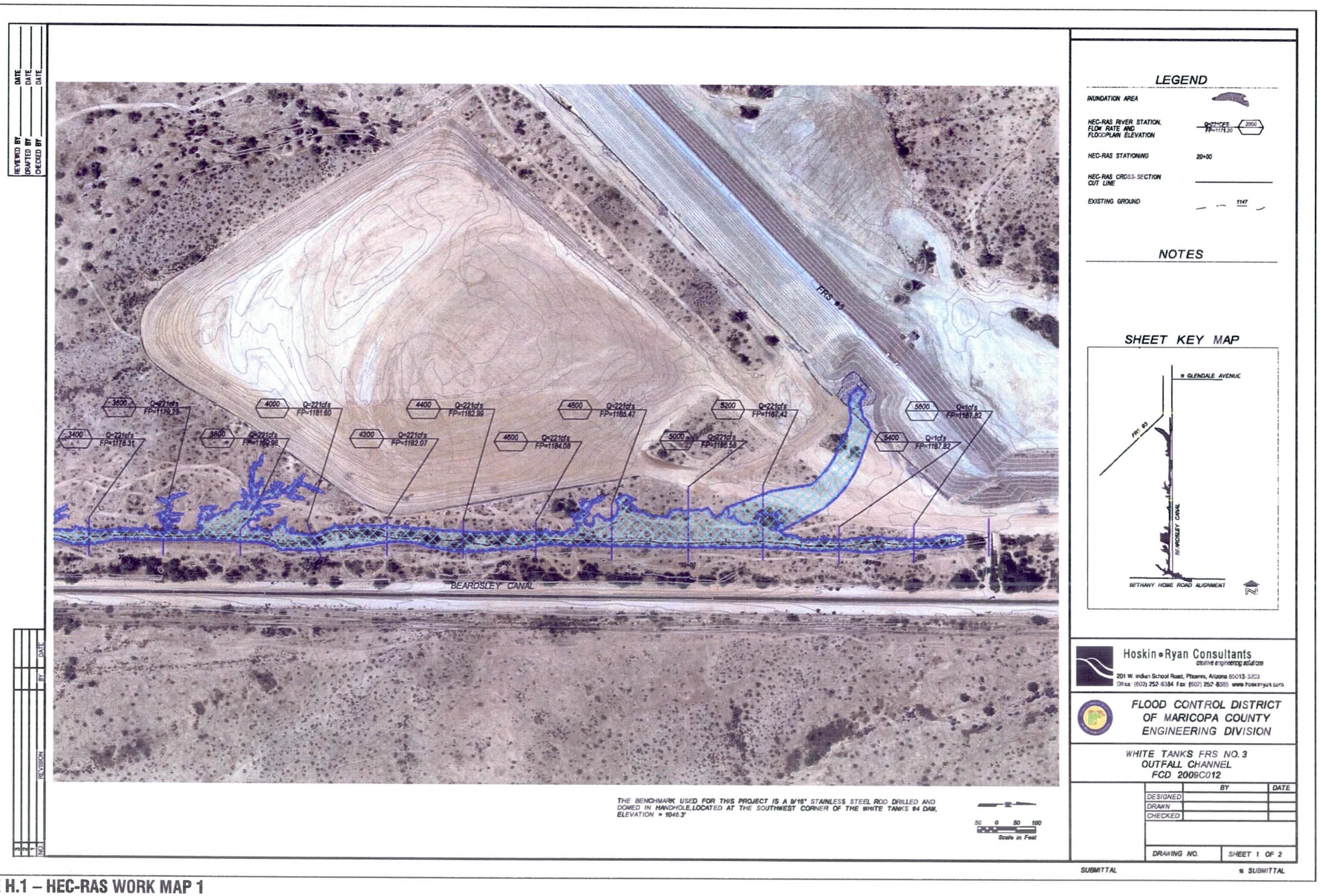
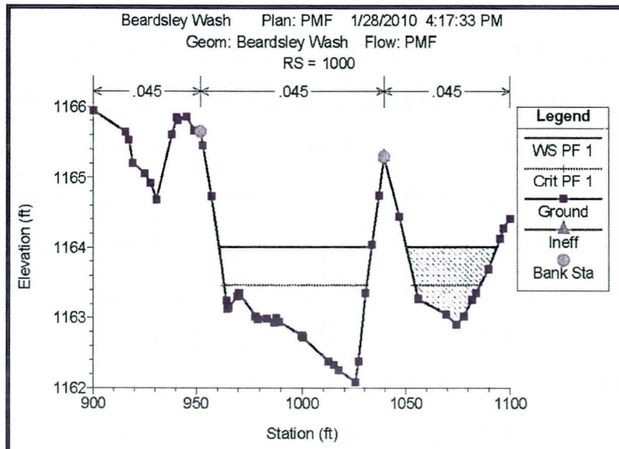
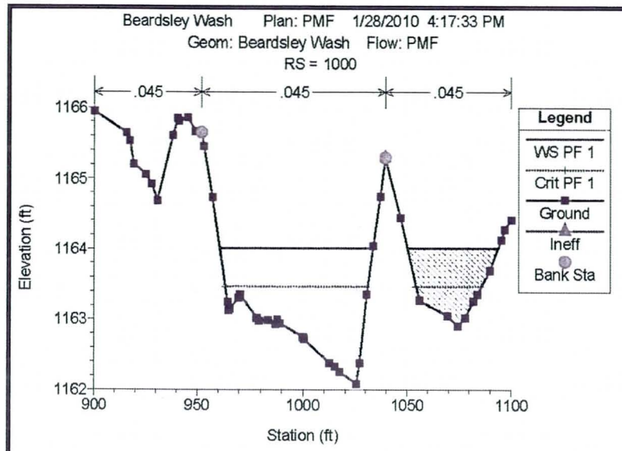
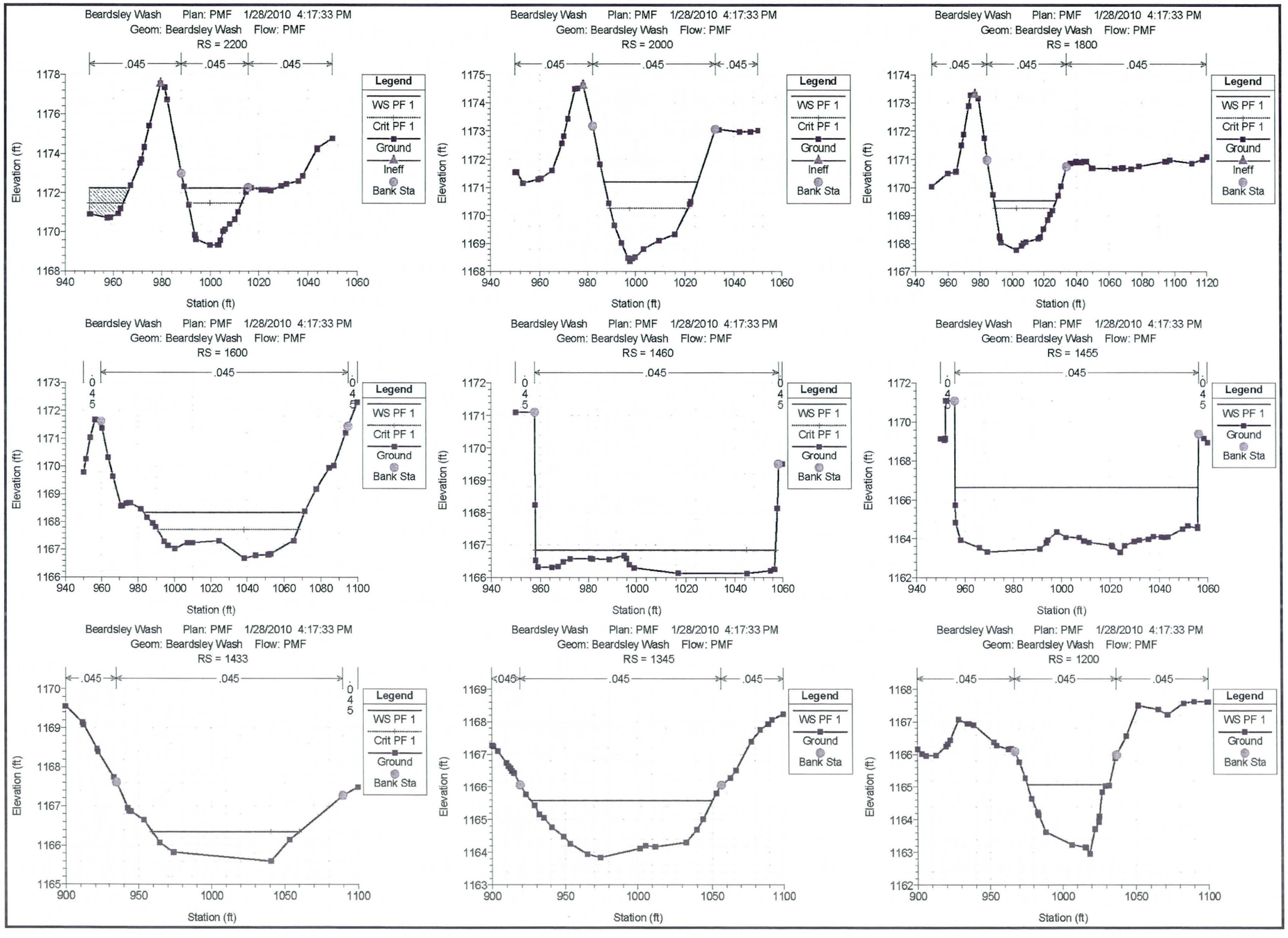
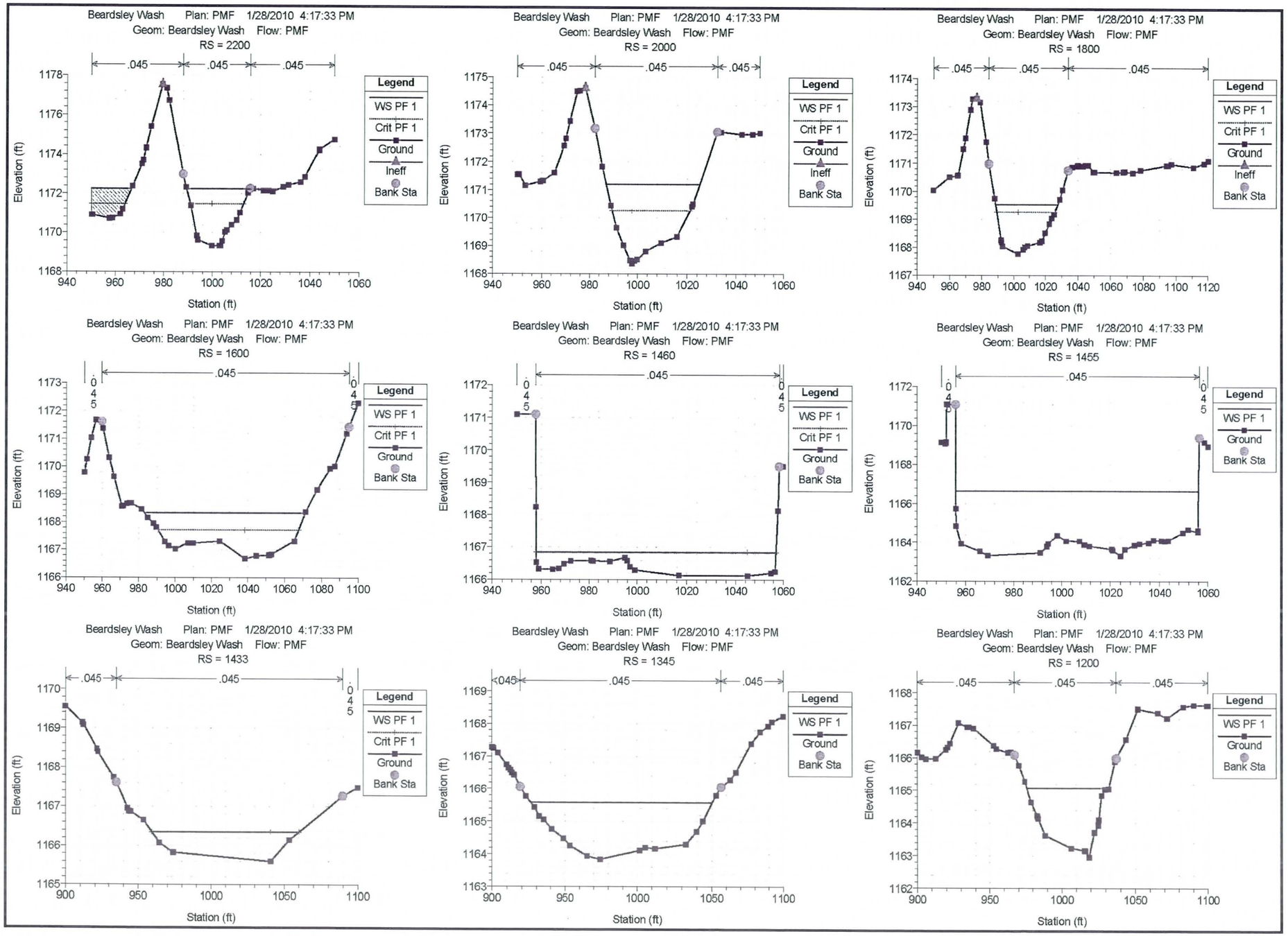


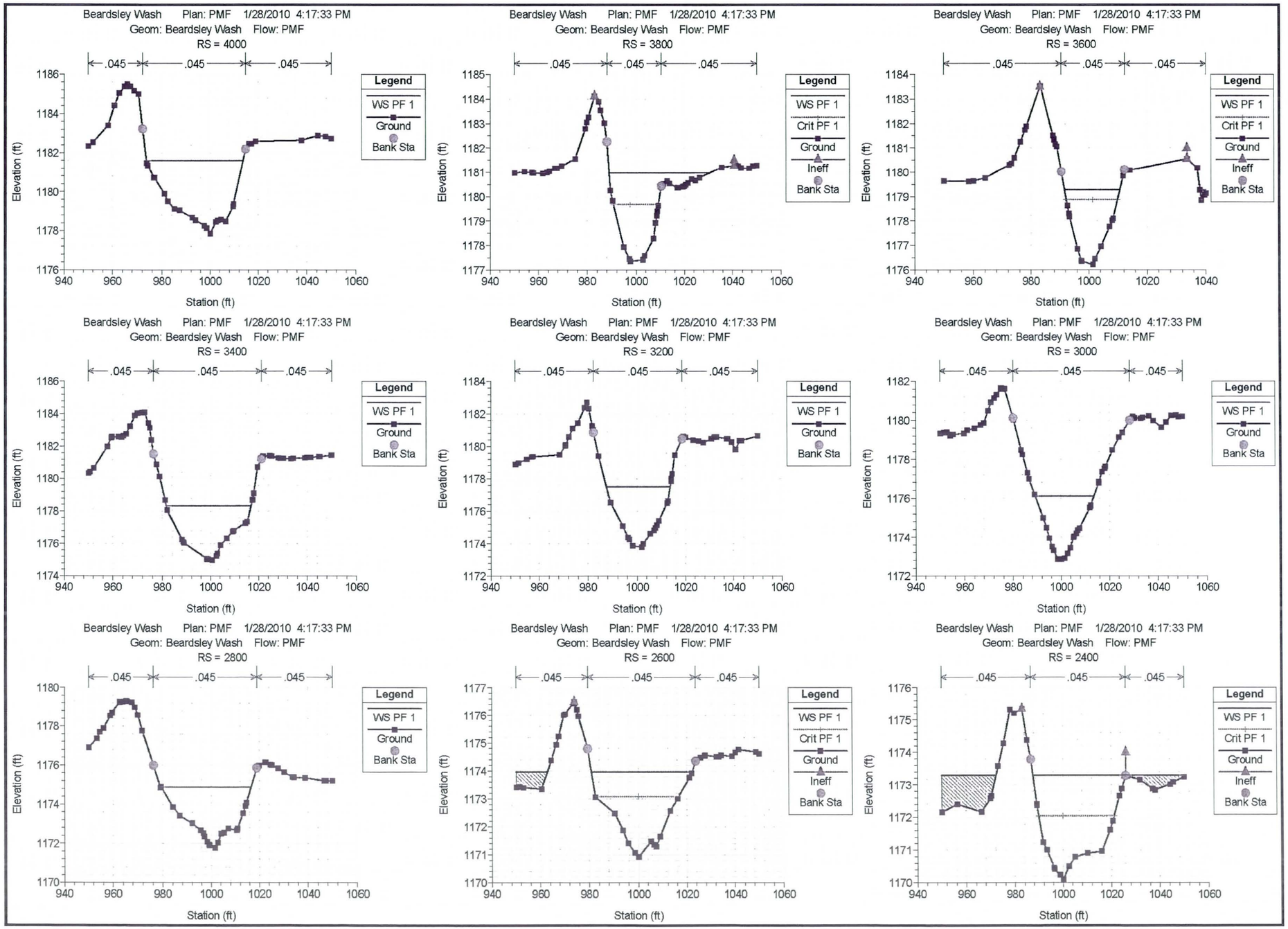
FIGURE H.1 – HEC-RAS WORK MAP 1

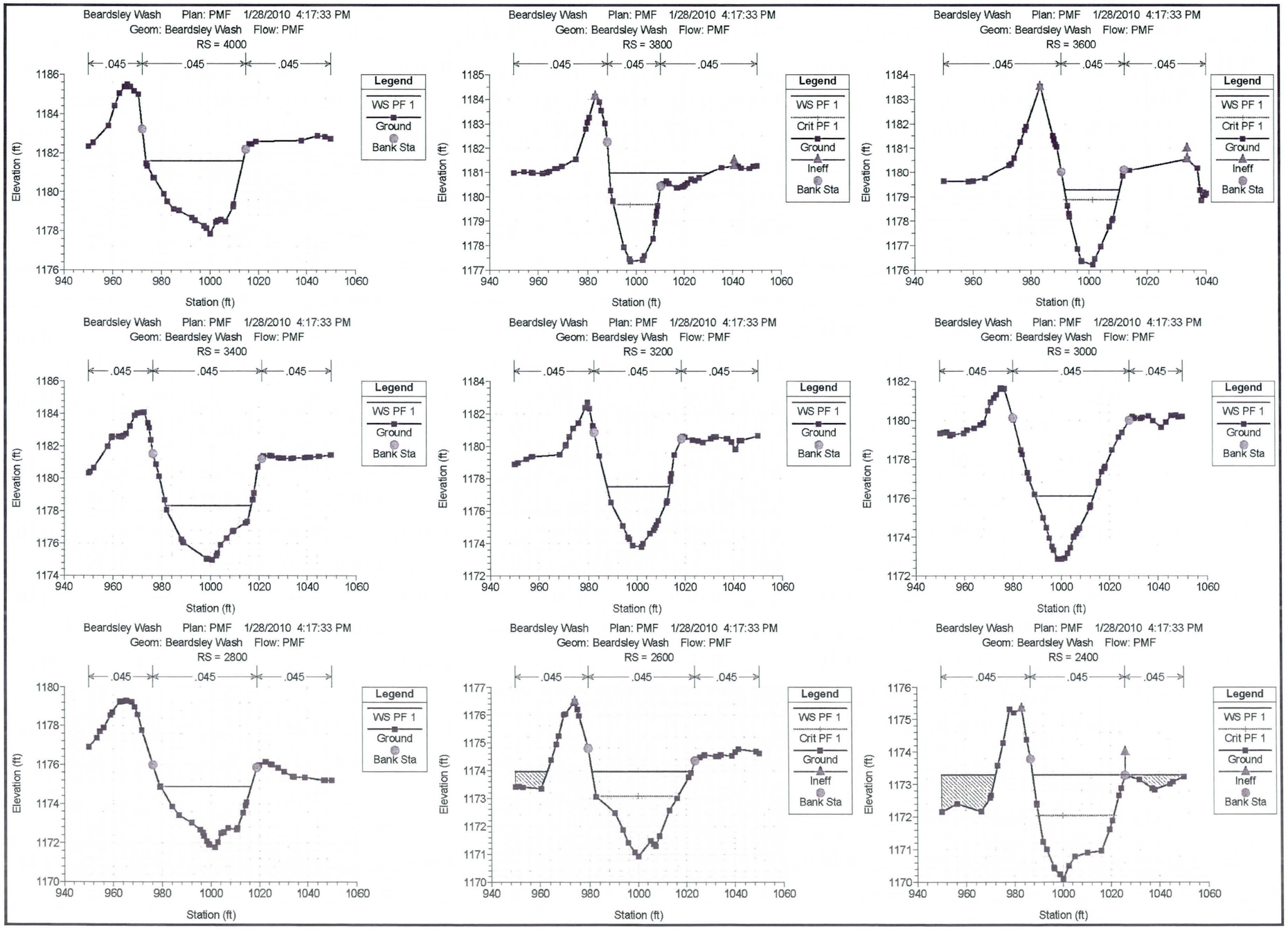

Beardsley Wash Plan: PMF 1/28/2010 4:17:33 PM
Geom: Beardsley Wash Flow: PMF
RS = 1000
.045
.045
.045
Legend
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
1166
1165
1164
1163
1162
900
950
1000
1050
1100
Station (ft)

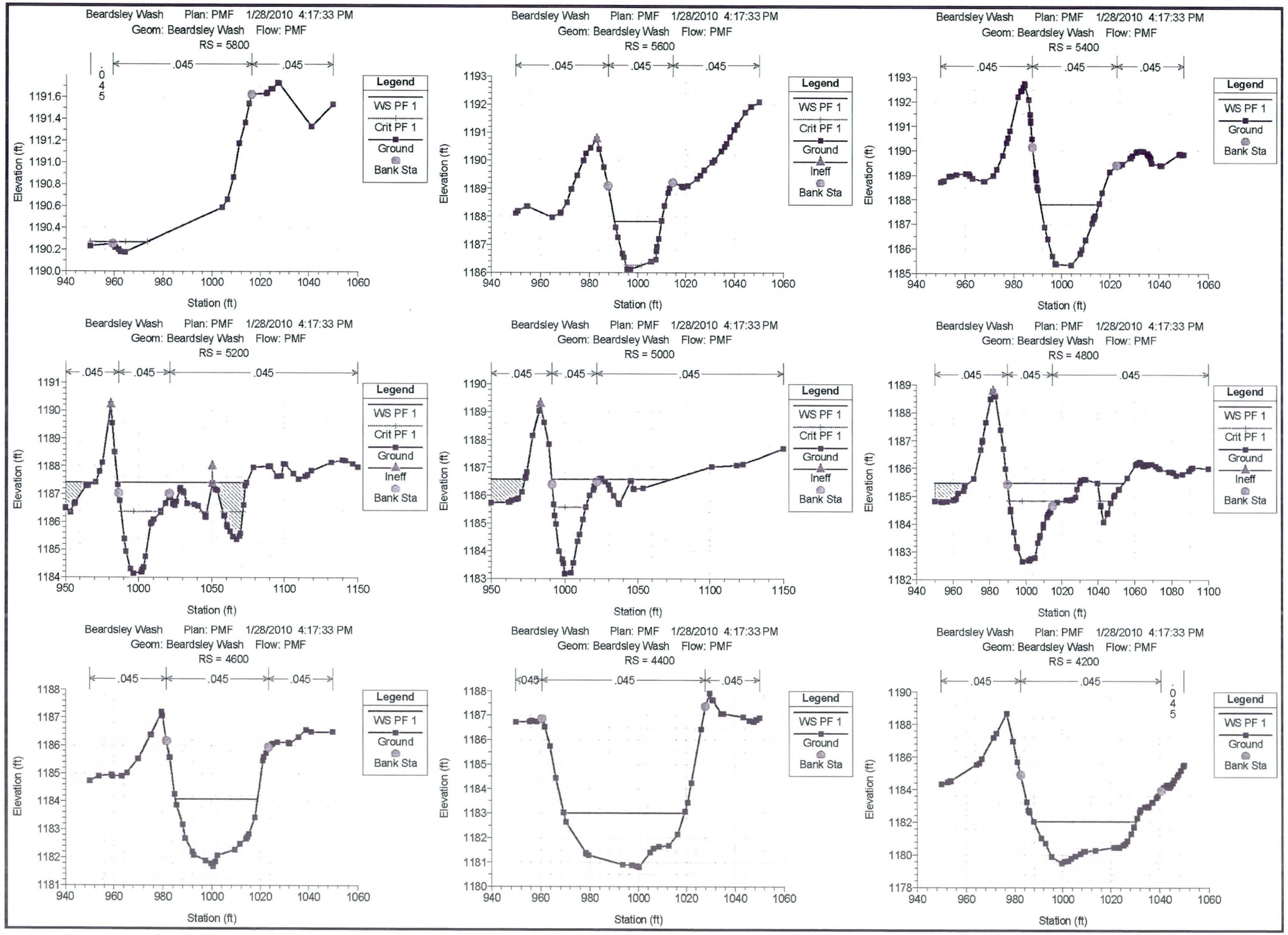

Beardsley Wash Plan: PMF 1/28/2010 4:17:33 PM
Geom: Beardsley Wash Flow: PMF
RS = 1000
.045
.045
.045
Legend
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
1166
1165
1164
1163
1162
900
950
1000
1050
1100
Station (ft)

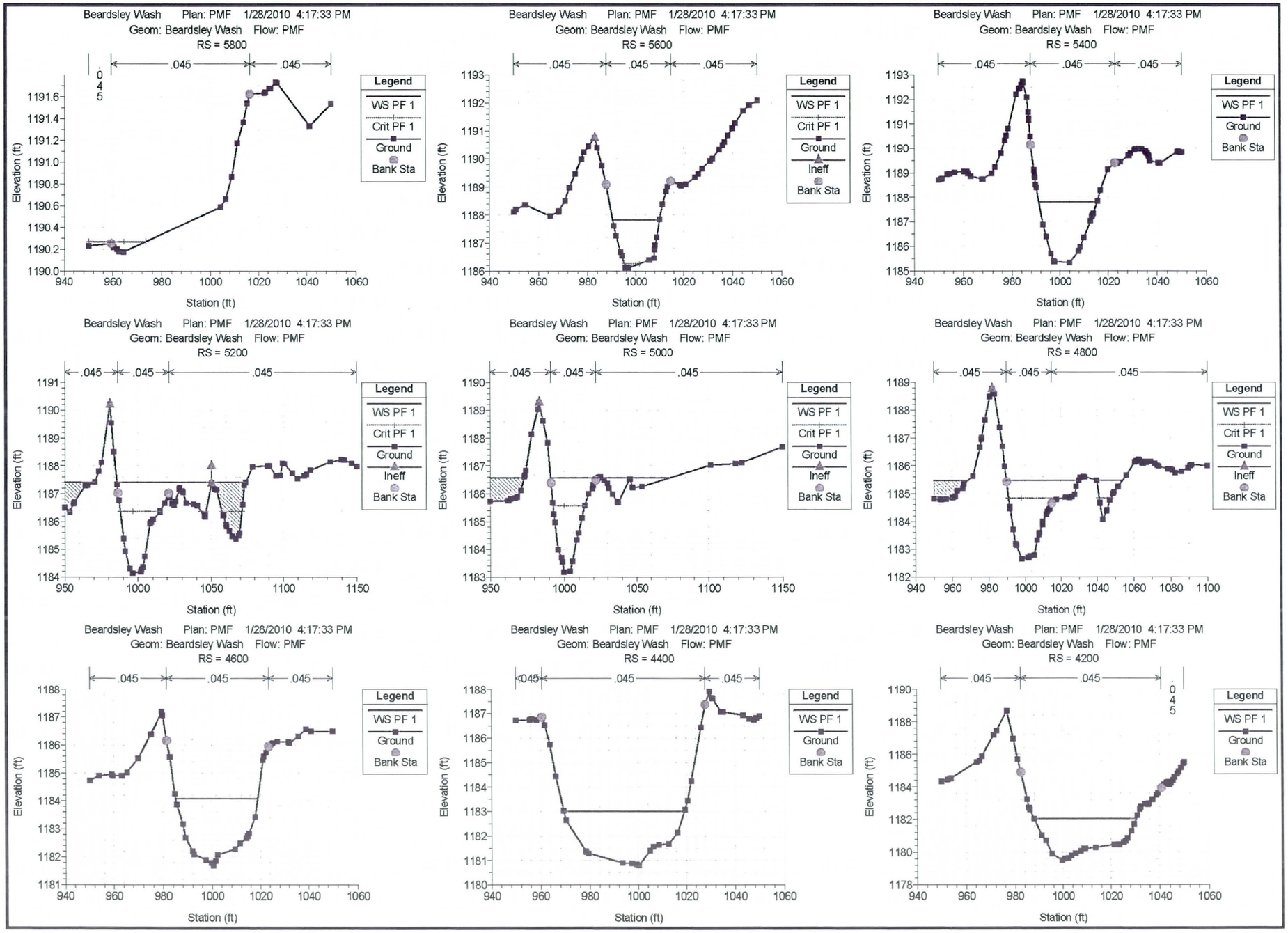

Beardsley Wash Plan: PMF 1/28/2010 4:17:33 PM
Geom: Beardsley Wash Flow: PMF
RS = 2200
RS = 2000
RS = 1800
RS = 1600
RS = 1460
RS = 1455
RS = 1433
RS = 1345
RS = 1200
Legend
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


Beardsley Wash Plan: PMF 1/28/2010 4:17:33 PM
Geom: Beardsley Wash Flow: PMF
RS = 2200
RS = 2000
RS = 1800
RS = 1600
RS = 1460
RS = 1455
RS = 1433
RS = 1345
RS = 1200
.045
Legend
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


Beardsley Wash Plan: PMF 1/28/2010 4:17:33 PM
Geom: Beardsley Wash Flow: PMF
RS = 4000
RS = 3800
RS = 3600
RS = 3400
RS = 3200
RS = 3000
RS = 2800
RS = 2600
RS = 2400
.045
Legend
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


Beardsley Wash Plan: PMF 1/28/2010 4:17:33 PM
Geom: Beardsley Wash Flow: PMF
RS = 4000
RS = 3800
RS = 3600
RS = 3400
RS = 3200
RS = 3000
RS = 2800
RS = 2600
RS = 2400
.045
Legend
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


Beardsley Wash Plan: PMF 1/28/2010 4:17:33 PM
Geom: Beardsley Wash Flow: PMF
RS = 5800
RS = 5600
RS = 5400
RS = 5200
RS = 5000
RS = 4800
RS = 4600
RS = 4400
RS = 4200
Legend
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
.045


Beardsley Wash Plan: PMF 1/28/2010 4:17:33 PM
Geom: Beardsley Wash Flow: PMF
RS = 5800
RS = 5600
RS = 5400
RS = 5200
RS = 5000
RS = 4800
RS = 4600
RS = 4400
RS = 4200
Legend
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
.045

SUMMARY OF REACH LENGTHS

River: Beardsley Wash

Reach	River Sta.	Left	Channel	Right
9	5800	200	200	200
9	5600	200	200	200
9	5400	200	200	200
9	5200	200	200	200
9	5000	200	200	200
9	4800	200	200	200
9	4600	200	200	200
9	4400	200	200	200
9	4200	200	200	200
9	4000	200	200	200
9	3800	200	200	200
9	3600	200	200	200
9	3400	200	200	200
9	3200	200	200	200
9	3000	200	200	200
9	2800	200	200	200
9	2600	200	200	200
9	2400	200	200	200
9	2200	200	200	200
9	2000	200	200	200
9	1800	200	200	200
9	1600	140	140	140
9	1460	5	5	5
9	1455	22	22	22
9	1433	70	88	96
9	1345	166	145	124
9	1200	200	200	200
9	1000	0	0	0

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: Beardsley Wash

Reach	River Sta.	Contr.	Expan.
9	5800	.1	.3
9	5600	.1	.3
9	5400	.1	.3
9	5200	.1	.3
9	5000	.1	.3
9	4800	.1	.3
9	4600	.1	.3
9	4400	.1	.3
9	4200	.1	.3
9	4000	.1	.3
9	3800	.1	.3
9	3600	.1	.3
9	3400	.1	.3
9	3200	.1	.3
9	3000	.1	.3
9	2800	.1	.3
9	2600	.1	.3
9	2400	.1	.3
9	2200	.1	.3
9	2000	.1	.3
9	1800	.1	.3
9	1600	.1	.3
9	1460	.1	.3
9	1455	.1	.3
9	1433	.1	.3
9	1345	.1	.3
9	1200	.1	.3
9	1000	.1	.3

SUMMARY OF REACH LENGTHS

River: Beardsley Wash

Reach	River Sta.	Left	Channel	Right
9	5800	200	200	200
9	5600	200	200	200
9	5400	200	200	200
9	5200	200	200	200
9	5000	200	200	200
9	4800	200	200	200
9	4600	200	200	200
9	4400	200	200	200
9	4200	200	200	200
9	4000	200	200	200
9	3800	200	200	200
9	3600	200	200	200
9	3400	200	200	200
9	3200	200	200	200
9	3000	200	200	200
9	2800	200	200	200
9	2600	200	200	200
9	2400	200	200	200
9	2200	200	200	200
9	2000	200	200	200
9	1800	200	200	200
9	1600	140	140	140
9	1460	5	5	5
9	1455	22	22	22
9	1433	70	88	96
9	1345	166	145	124
9	1200	200	200	200
9	1000	0	0	0

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: Beardsley Wash

Reach	River Sta.	Contr.	Expan.
9	5800	.1	.3
9	5600	.1	.3
9	5400	.1	.3
9	5200	.1	.3
9	5000	.1	.3
9	4800	.1	.3
9	4600	.1	.3
9	4400	.1	.3
9	4200	.1	.3
9	4000	.1	.3
9	3800	.1	.3
9	3600	.1	.3
9	3400	.1	.3
9	3200	.1	.3
9	3000	.1	.3
9	2800	.1	.3
9	2600	.1	.3
9	2400	.1	.3
9	2200	.1	.3
9	2000	.1	.3
9	1800	.1	.3
9	1600	.1	.3
9	1460	.1	.3
9	1455	.1	.3
9	1433	.1	.3
9	1345	.1	.3
9	1200	.1	.3
9	1000	.1	.3

H.2 HEC-RAS MODEL

```
                    HEC-RAS Version 4.0.0 March 2008
                      U.S. Army Corps of Engineers
                    Hydrologic Engineering Center
                          609 Second Street
                          Davis, California

          X     X  XXXXXX    XXXX        XXXX       XX      XXXX
          X     X  X        X    X       X   X     X  X    X
          X     X  X        X            X   X    X    X   X
          XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
          X     X  X        X            X  X     X    X        X
          X     X  X        X    X       X   X    X    X        X
          X     X  XXXXXX    XXXX        X    X   X    X   XXXXX

*****************************************************************************

PROJECT DATA
Project Title: Beardsley Wash
Project File : Beardsley.prj
Run Date and Time: 1/28/2010 4:17:33 PM

Project in English units

Project Description:
Project: Beardsley Wash PMF Floodplain
Hoskin Ryan
Consultants
12/28/2009

Cross-secttion geometries obtained from the aerial
mapping prepared by Cooper Aerial on 12/22/2009
Wash center line lies on
Station 1000 at each cross-section
Datum: NAVD 88


*****************************************************************************

PLAN DATA

Plan Title: PMF
Plan File : G:\Projects\09\09-077 WTO3 Final\01 - 30% Design\Hydro\HEC-RAS\Beardsley.p01

          Geometry Title: Beardsley Wash
          Geometry File : G:\Projects\09\09-077 WTO3 Final\01 - 30% Design\Hydro\HEC-RAS\Beardsley.g01

          Flow Title    : PMF
          Flow File     : G:\Projects\09\09-077 WTO3 Final\01 - 30% Design\Hydro\HEC-RAS\Beardsley.f01

Plan Summary Information:
Number of:  Cross Sections =   28    Multiple Openings  =    0
            Culverts       =    0    Inline Structures  =    0
            Bridges        =    0    Lateral Structures =    0

Computational Information
    Water surface calculation tolerance  =  0.01
    Critical depth calculation tolerance =  0.01
    Maximum number of iterations         =  20
    Maximum difference tolerance         =  0.3
    Flow tolerance factor                =  0.001

Computation Options
    Critical depth computed only where necessary
    Conveyance Calculation Method: At breaks in n values only
    Friction Slope Method:         Average Conveyance
    Computational Flow Regime:     Subcritical Flow


*****************************************************************************

FLOW DATA

Flow Title: PMF
Flow File : G:\Projects\09\09-077 WTO3 Final\01 - 30% Design\Hydro\HEC-RAS\Beardsley.f01

Flow Data (cfs)
*************************************************************
* River           Reach           RS      *            PF 1 *
* Beardsley Wash  9               5800    *               1 *
* Beardsley Wash  9               5200    *             221 *
*************************************************************

Boundary Conditions
*****************************************************************************************************************
* River           Reach           Profile          *            Upstream                Downstream    *
*****************************************************************************************************************
* Beardsley Wash  9               PF 1             *                                 Normal S = 0.005 *
*****************************************************************************************************************

*****************************************************************************

SUMMARY OF MANNING'S N VALUES

River:Beardsley Wash
*****************************************************************
*     Reach       *   River Sta.   *   n1     *   n2     *   n3     *
*****************************************************************
*9                *    5800        *     .045*     .045*     .045*
*9                *    5600        *     .045*     .045*     .045*
*9                *    5400        *     .045*     .045*     .045*
*9                *    5200        *     .045*     .045*     .045*
*9                *    5000        *     .045*     .045*     .045*
*9                *    4800        *     .045*     .045*     .045*
*9                *    4600        *     .045*     .045*     .045*
*9                *    4400        *     .045*     .045*     .045*
*9                *    4200        *     .045*     .045*     .045*
*9                *    4000        *     .045*     .045*     .045*
*9                *    3800        *     .045*     .045*     .045*
*9                *    3600        *     .045*     .045*     .045*
*9                *    3400        *     .045*     .045*     .045*
*9                *    3200        *     .045*     .045*     .045*
*9                *    3000        *     .045*     .045*     .045*
*9                *    2800        *     .045*     .045*     .045*
*9                *    2600        *     .045*     .045*     .045*
*9                *    2400        *     .045*     .045*     .045*
*9                *    2200        *     .045*     .045*     .045*
*9                *    2000        *     .045*     .045*     .045*
*9                *    1800        *     .045*     .045*     .045*
*9                *    1600        *     .045*     .045*     .045*
*9                *    1460        *     .045*     .045*     .045*
*9                *    1455        *     .045*     .045*     .045*
*9                *    1433        *     .045*     .045*     .045*
*9                *    1345        *     .045*     .045*     .045*
*9                *    1200        *     .045*     .045*     .045*
*9                *    1000        *     .045*     .045*     .045*
*****************************************************************

*****************************************************************************
```

H.2 HEC-RAS MODEL

```
                    HEC-RAS Version 4.0.0 March 2008
                      U.S. Army Corps of Engineers
                    Hydrologic Engineering Center
                          609 Second Street
                          Davis, California

          X     X  XXXXXX    XXXX        XXXX       XX      XXXX
          X     X  X        X    X       X   X     X  X    X
          X     X  X        X            X   X    X    X   X
          XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
          X     X  X        X            X  X     X    X        X
          X     X  X        X    X       X   X    X    X        X
          X     X  XXXXXX    XXXX        X    X   X    X   XXXXX

*******************************************************************************

PROJECT DATA
Project Title: Beardsley Wash
Project File : Beardsley.prj
Run Date and Time: 1/28/2010 4:17:33 PM

Project in English units

Project Description:
Project: Beardsley Wash PMF Floodplain
Hoskin Ryan
Consultants
12/28/2009

Cross-secttion geometries obtained from the aerial
mapping prepared by Cooper Aerial on 12/22/2009
Wash center line lies on
Station 1000 at each cross-section
Datum: NAVD 88


*******************************************************************************

PLAN DATA

Plan Title: PMF
Plan File : G:\Projects\09\09-077 WTO3 Final\01 - 30% Design\Hydro\HEC-RAS\Beardsley.p01

          Geometry Title: Beardsley Wash
          Geometry File : G:\Projects\09\09-077 WTO3 Final\01 - 30% Design\Hydro\HEC-RAS\Beardsley.g01

          Flow Title    : PMF
          Flow File     : G:\Projects\09\09-077 WTO3 Final\01 - 30% Design\Hydro\HEC-RAS\Beardsley.f01

Plan Summary Information:
Number of:  Cross Sections =   28    Multiple Openings  =    0
            Culverts       =    0    Inline Structures  =    0
            Bridges        =    0    Lateral Structures =    0

Computational Information
    Water surface calculation tolerance  =  0.01
    Critical depth calculation tolerance =  0.01
    Maximum number of iterations         =  20
    Maximum difference tolerance         =  0.3
    Flow tolerance factor                =  0.001

Computation Options
    Critical depth computed only where necessary
    Conveyance Calculation Method: At breaks in n values only
    Friction Slope Method:         Average Conveyance
    Computational Flow Regime:     Subcritical Flow


*******************************************************************************

FLOW DATA

Flow Title: PMF
Flow File : G:\Projects\09\09-077 WTO3 Final\01 - 30% Design\Hydro\HEC-RAS\Beardsley.f01

Flow Data (cfs)
*************************************************************
* River           Reach           RS      *            PF 1 *
* Beardsley Wash  9               5800    *               1 *
* Beardsley Wash  9               5200    *             221 *
*************************************************************

Boundary Conditions
*****************************************************************************************************************
* River           Reach           Profile          *            Upstream                 Downstream     *
*****************************************************************************************************************
* Beardsley Wash  9               PF 1             *                                   Normal S = 0.005 *
*****************************************************************************************************************


*******************************************************************************

SUMMARY OF MANNING'S N VALUES

River:Beardsley Wash
*******************************************************************
*     Reach       *   River Sta.   *   n1     *   n2     *   n3     *
*******************************************************************
*9                *    5800        *     .045*     .045*     .045*
*9                *    5600        *     .045*     .045*     .045*
*9                *    5400        *     .045*     .045*     .045*
*9                *    5200        *     .045*     .045*     .045*
*9                *    5000        *     .045*     .045*     .045*
*9                *    4800        *     .045*     .045*     .045*
*9                *    4600        *     .045*     .045*     .045*
*9                *    4400        *     .045*     .045*     .045*
*9                *    4200        *     .045*     .045*     .045*
*9                *    4000        *     .045*     .045*     .045*
*9                *    3800        *     .045*     .045*     .045*
*9                *    3600        *     .045*     .045*     .045*
*9                *    3400        *     .045*     .045*     .045*
*9                *    3200        *     .045*     .045*     .045*
*9                *    3000        *     .045*     .045*     .045*
*9                *    2800        *     .045*     .045*     .045*
*9                *    2600        *     .045*     .045*     .045*
*9                *    2400        *     .045*     .045*     .045*
*9                *    2200        *     .045*     .045*     .045*
*9                *    2000        *     .045*     .045*     .045*
*9                *    1800        *     .045*     .045*     .045*
*9                *    1600        *     .045*     .045*     .045*
*9                *    1460        *     .045*     .045*     .045*
*9                *    1455        *     .045*     .045*     .045*
*9                *    1433        *     .045*     .045*     .045*
*9                *    1345        *     .045*     .045*     .045*
*9                *    1200        *     .045*     .045*     .045*
*9                *    1000        *     .045*     .045*     .045*
*******************************************************************

*******************************************************************************
```

APPENDIX H – WASTEWAY FLOW INUNDATION

H.1 MANNING'S ROUGHNESS COEFFICIENT

Per Table 2 of the *Selection of Manning's Roughness Coefficient for Natural and Constructed Vegetated and Non-Vegetated Channels, and Vegetation Maintenance Plan Guidelines for Vegetated Channels in Central Arizona* (USGS, 2007), a base value of 0.020 was selected for the Manning's n of the Beardsley Wash. The vegetation along the wash was investigated from the oblique and orthogonal photos provided by Cooper Aerial in December 2009 and February 2010. Given an average flow depth of 3 feet, it is estimated that trees such as mesquite or palo verde blocks 5%-20% of the flow area. Per Table 3 of the same reference (USGS, 2007), an adjustment factor of 0.025 was selected for the Manning's n of the Beardsley Wash. Therefore, a Manning's n of 0.045 was used in HEC-RAS models to identify inundation profile along the wash. Two photos were provided here to indicate the vegetation density.

Photo 1: Oblique photo looking north

Photo 2: Aerial photo showing the vegetation density within the floodplain

APPENDIX H – WASTEWAY FLOW INUNDATION

H.1 MANNING'S ROUGHNESS COEFFICIENT

Per Table 2 of the *Selection of Manning's Roughness Coefficient for Natural and Constructed Vegetated and Non-Vegetated Channels, and Vegetation Maintenance Plan Guidelines for Vegetated Channels in Central Arizona* (USGS, 2007), a base value of 0.020 was selected for the Manning's n of the Beardsley Wash. The vegetation along the wash was investigated from the oblique and orthogonal photos provided by Cooper Aerial in December 2009 and February 2010. Given an average flow depth of 3 feet, it is estimated that trees such as mesquite or palo verde blocks 5%-20% of the flow area. Per Table 3 of the same reference (USGS, 2007), an adjustment factor of 0.025 was selected for the Manning's n of the Beardsley Wash. Therefore, a Manning's n of 0.045 was used in HEC-RAS models to identify inundation profile along the wash. Two photos were provided here to indicate the vegetation density.

Photo 1: Oblique photo looking north

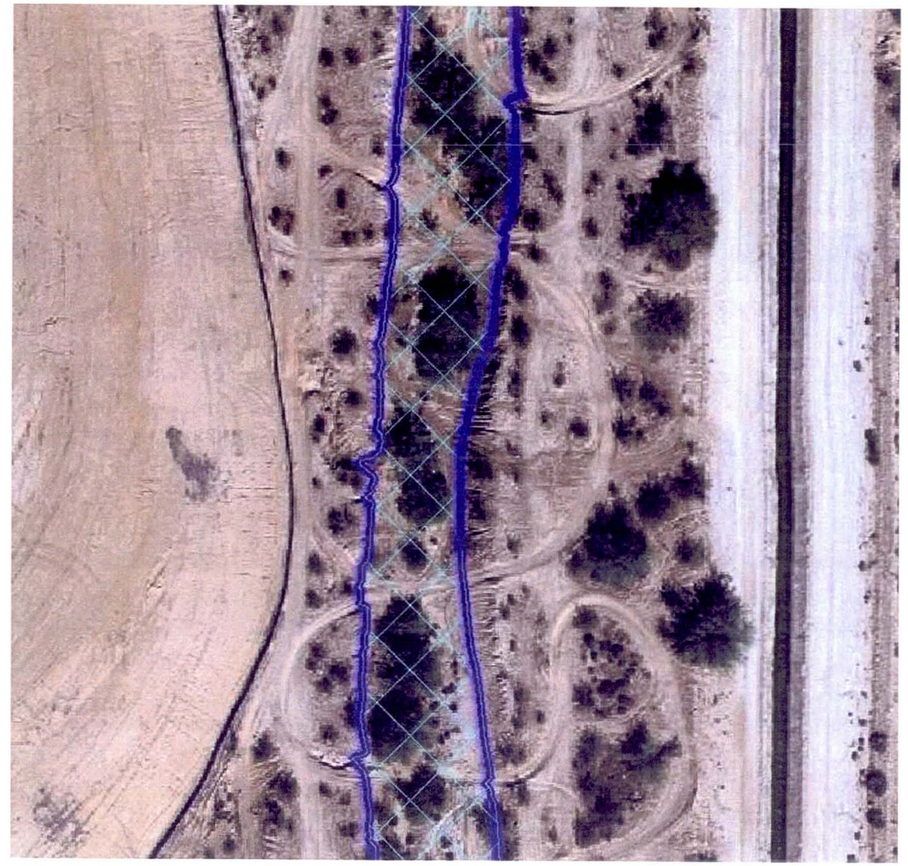


Photo 2: Aerial photo showing the vegetation density within the floodplain

APPENDIX H – WASTEWAY FLOW INUNDATION

H.1 MANNING'S ROUGHNESS COEFFICIENT

Per Table 2 of the *Selection of Manning's Roughness Coefficient for Natural and Constructed Vegetated and Non-Vegetated Channels, and Vegetation Maintenance Plan Guidelines for Vegetated Channels in Central Arizona* (USGS, 2007), a base value of 0.020 was selected for the Manning's n of the Beardsley Wash. The vegetation along the wash was investigated from the oblique and orthogonal photos provided by Cooper Aerial in December 2009 and February 2010. Given an average flow depth of 3 feet, it is estimated that trees such as mesquite or palo verde blocks 5%-20% of the flow area. Per Table 3 of the same reference (USGS, 2007), an adjustment factor of 0.025 was selected for the Manning's n of the Beardsley Wash. Therefore, a Manning's n of 0.045 was used in HEC-RAS models to identify inundation profile along the wash. Two photos were provided here to indicate the vegetation density.

Photo 1: Oblique photo looking north

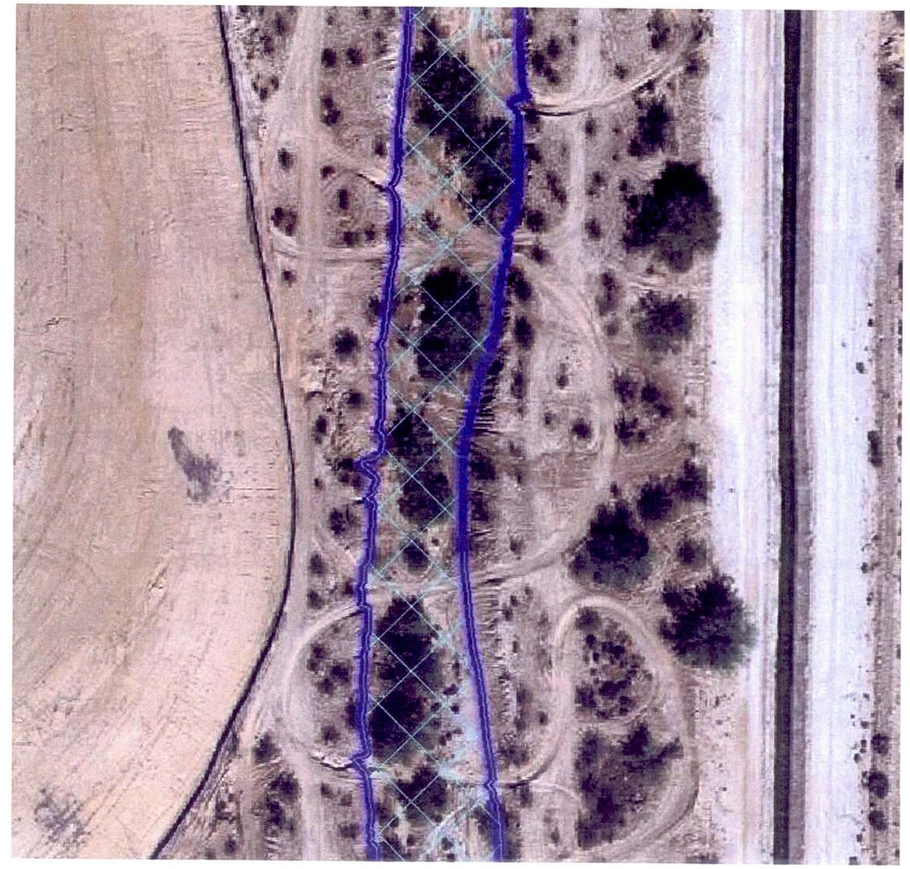


Photo 2: Aerial photo showing the vegetation density within the floodplain

H.2 HEC-RAS MODEL

```
                    HEC-RAS Version 4.0.0 March 2008
                      U.S. Army Corps of Engineers
                    Hydrologic Engineering Center
                          609 Second Street
                          Davis, California

          X     X  XXXXXX    XXXX        XXXX       XX      XXXX
          X     X  X        X    X       X   X     X  X    X
          X     X  X        X            X   X    X    X   X
          XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
          X     X  X        X            X  X     X    X        X
          X     X  X        X    X       X   X    X    X        X
          X     X  XXXXXX    XXXX        X    X   X    X   XXXXX

*******************************************************************************

PROJECT DATA
Project Title: Beardsley Wash
Project File : Beardsley.prj
Run Date and Time: 1/28/2010 4:17:33 PM

Project in English units

Project Description:
Project: Beardsley Wash PMF Floodplain
Hoskin Ryan
Consultants
12/28/2009

Cross-secttion geometries obtained from the aerial
mapping prepared by Cooper Aerial on 12/22/2009
Wash center line lies on
Station 1000 at each cross-section
Datum: NAVD 88


*******************************************************************************

PLAN DATA

Plan Title: PMF
Plan File : G:\Projects\09\09-077 WTO3 Final\01 - 30% Design\Hydro\HEC-RAS\Beardsley.p01

          Geometry Title: Beardsley Wash
          Geometry File : G:\Projects\09\09-077 WTO3 Final\01 - 30% Design\Hydro\HEC-RAS\Beardsley.g01

          Flow Title    : PMF
          Flow File     : G:\Projects\09\09-077 WTO3 Final\01 - 30% Design\Hydro\HEC-RAS\Beardsley.f01

Plan Summary Information:
Number of:  Cross Sections =   28    Multiple Openings  =    0
            Culverts       =    0    Inline Structures  =    0
            Bridges        =    0    Lateral Structures =    0

Computational Information
    Water surface calculation tolerance  =  0.01
    Critical depth calculation tolerance =  0.01
    Maximum number of iterations         =  20
    Maximum difference tolerance         =  0.3
    Flow tolerance factor                =  0.001

Computation Options
    Critical depth computed only where necessary
    Conveyance Calculation Method: At breaks in n values only
    Friction Slope Method:         Average Conveyance
    Computational Flow Regime:     Subcritical Flow


*******************************************************************************

FLOW DATA

Flow Title: PMF
Flow File : G:\Projects\09\09-077 WTO3 Final\01 - 30% Design\Hydro\HEC-RAS\Beardsley.f01

Flow Data (cfs)
*************************************************************
* River           Reach           RS      *            PF 1 *
* Beardsley Wash  9               5800    *               1 *
* Beardsley Wash  9               5200    *             221 *
*************************************************************

Boundary Conditions
*****************************************************************************************************************
* River           Reach           Profile         *            Upstream                 Downstream    *
*****************************************************************************************************************
* Beardsley Wash  9               PF 1            *                                   Normal S = 0.005 *
*****************************************************************************************************************

*******************************************************************************

SUMMARY OF MANNING'S N VALUES

River:Beardsley Wash
*****************************************************************
*     Reach       *   River Sta.   *   n1    *   n2    *   n3    *
*****************************************************************
*9                *    5800        *     .045*     .045*     .045*
*9                *    5600        *     .045*     .045*     .045*
*9                *    5400        *     .045*     .045*     .045*
*9                *    5200        *     .045*     .045*     .045*
*9                *    5000        *     .045*     .045*     .045*
*9                *    4800        *     .045*     .045*     .045*
*9                *    4600        *     .045*     .045*     .045*
*9                *    4400        *     .045*     .045*     .045*
*9                *    4200        *     .045*     .045*     .045*
*9                *    4000        *     .045*     .045*     .045*
*9                *    3800        *     .045*     .045*     .045*
*9                *    3600        *     .045*     .045*     .045*
*9                *    3400        *     .045*     .045*     .045*
*9                *    3200        *     .045*     .045*     .045*
*9                *    3000        *     .045*     .045*     .045*
*9                *    2800        *     .045*     .045*     .045*
*9                *    2600        *     .045*     .045*     .045*
*9                *    2400        *     .045*     .045*     .045*
*9                *    2200        *     .045*     .045*     .045*
*9                *    2000        *     .045*     .045*     .045*
*9                *    1800        *     .045*     .045*     .045*
*9                *    1600        *     .045*     .045*     .045*
*9                *    1460        *     .045*     .045*     .045*
*9                *    1455        *     .045*     .045*     .045*
*9                *    1433        *     .045*     .045*     .045*
*9                *    1345        *     .045*     .045*     .045*
*9                *    1200        *     .045*     .045*     .045*
*9                *    1000        *     .045*     .045*     .045*
*****************************************************************

*******************************************************************************
```

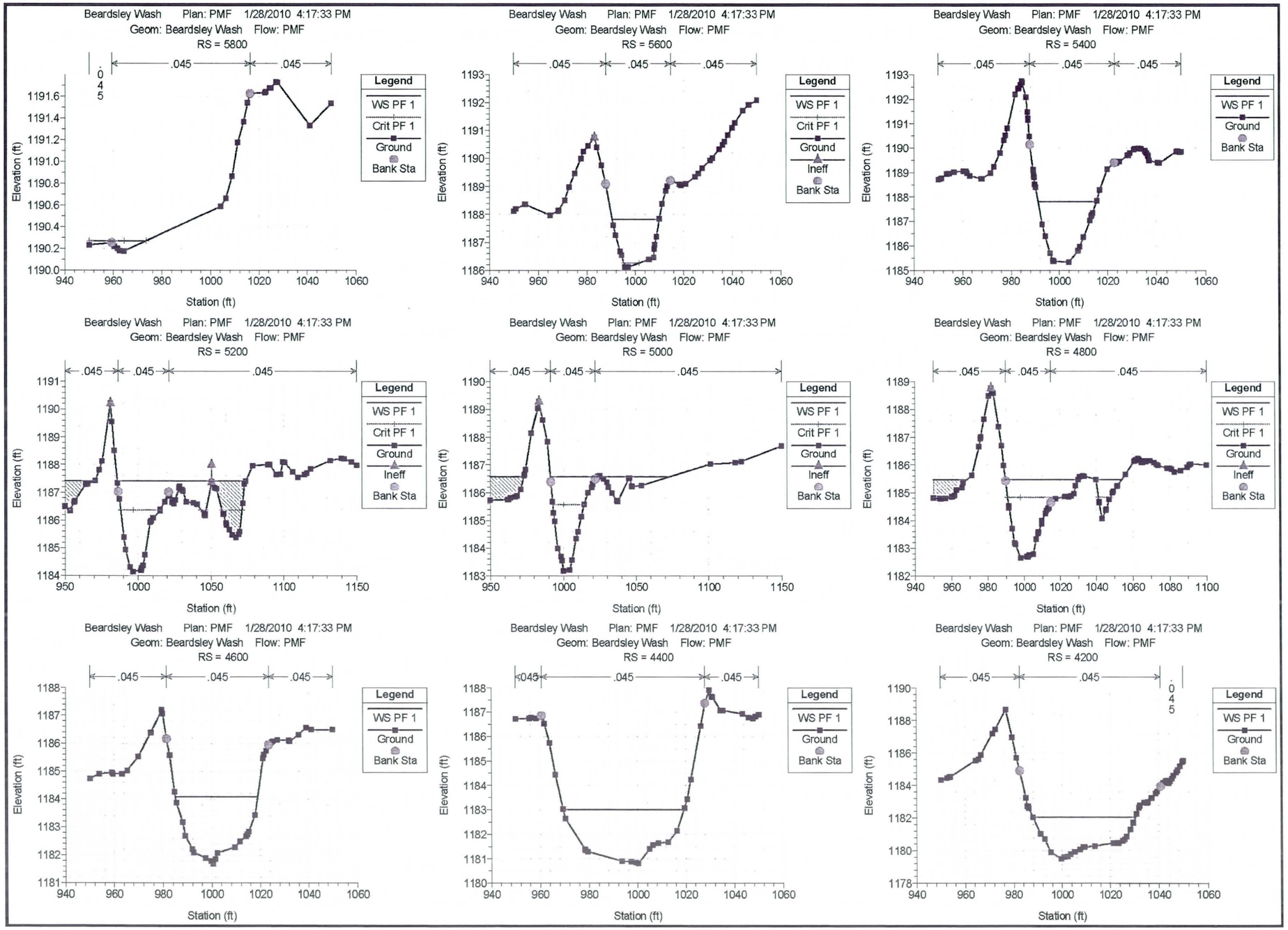
SUMMARY OF REACH LENGTHS

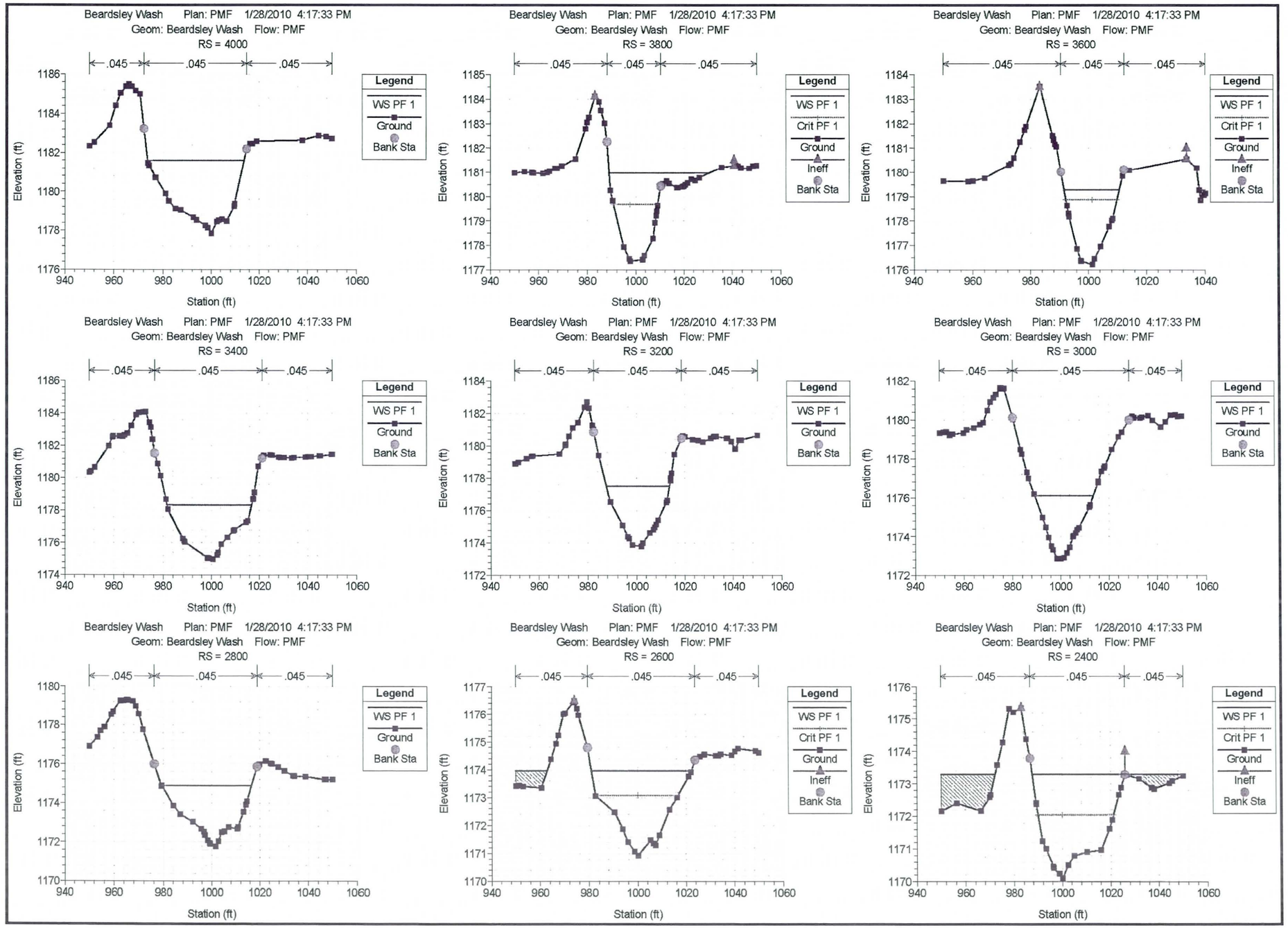
River: Beardsley Wash

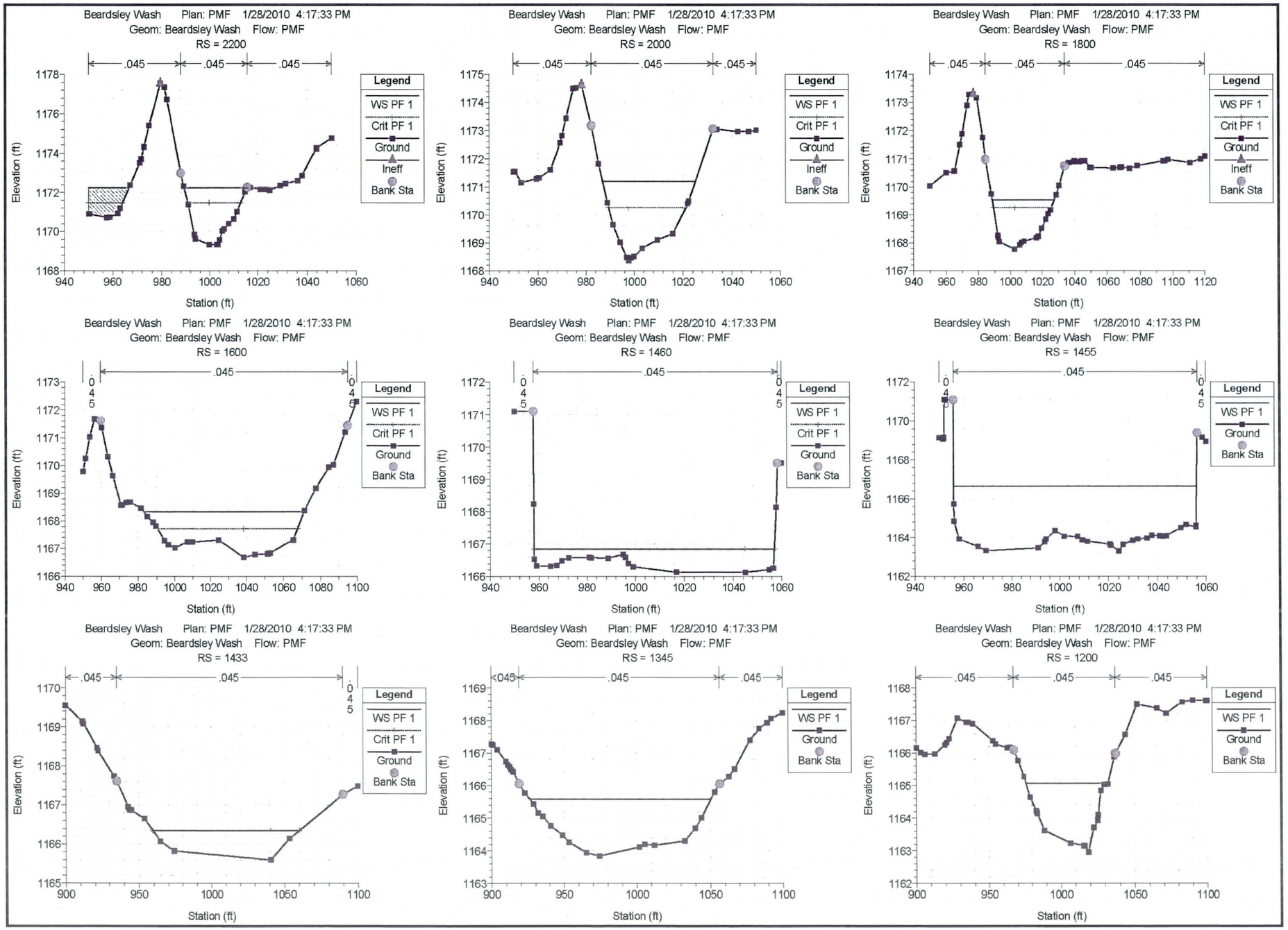
Reach	River Sta.	Left	Channel	Right
9	5800	200	200	200
9	5600	200	200	200
9	5400	200	200	200
9	5200	200	200	200
9	5000	200	200	200
9	4800	200	200	200
9	4600	200	200	200
9	4400	200	200	200
9	4200	200	200	200
9	4000	200	200	200
9	3800	200	200	200
9	3600	200	200	200
9	3400	200	200	200
9	3200	200	200	200
9	3000	200	200	200
9	2800	200	200	200
9	2600	200	200	200
9	2400	200	200	200
9	2200	200	200	200
9	2000	200	200	200
9	1800	200	200	200
9	1600	140	140	140
9	1460	5	5	5
9	1455	22	22	22
9	1433	70	88	96
9	1345	166	145	124
9	1200	200	200	200
9	1000	0	0	0

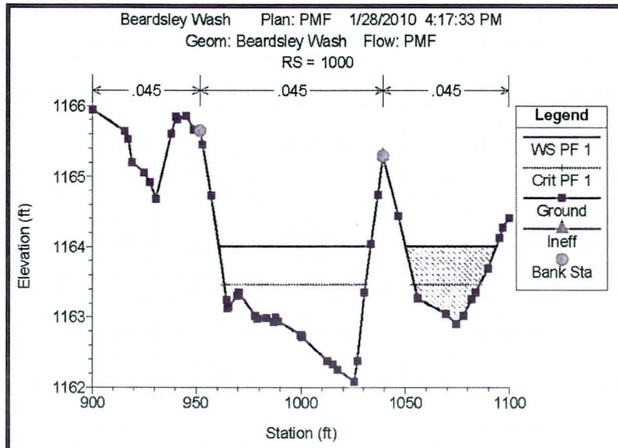
SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: Beardsley Wash

Reach	River Sta.	Contr.	Expan.
9	5800	.1	.3
9	5600	.1	.3
9	5400	.1	.3
9	5200	.1	.3
9	5000	.1	.3
9	4800	.1	.3
9	4600	.1	.3
9	4400	.1	.3
9	4200	.1	.3
9	4000	.1	.3
9	3800	.1	.3
9	3600	.1	.3
9	3400	.1	.3
9	3200	.1	.3
9	3000	.1	.3
9	2800	.1	.3
9	2600	.1	.3
9	2400	.1	.3
9	2200	.1	.3
9	2000	.1	.3
9	1800	.1	.3
9	1600	.1	.3
9	1460	.1	.3
9	1455	.1	.3
9	1433	.1	.3
9	1345	.1	.3
9	1200	.1	.3
9	1000	.1	.3


Beardsley Wash Plan: PMF 1/28/2010 4:17:33 PM
Geom: Beardsley Wash Flow: PMF
RS = 5800
RS = 5600
RS = 5400
RS = 5200
RS = 5000
RS = 4800
RS = 4600
RS = 4400
RS = 4200
.045
Legend
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


Beardsley Wash Plan: PMF 1/28/2010 4:17:33 PM
Geom: Beardsley Wash Flow: PMF
RS = 4000
RS = 3800
RS = 3600
RS = 3400
RS = 3200
RS = 3000
RS = 2800
RS = 2600
RS = 2400
.045
Elevation (ft)
Station (ft)
Legend
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta


Beardsley Wash Plan: PMF 1/28/2010 4:17:33 PM
Geom: Beardsley Wash Flow: PMF
RS = 2200
RS = 2000
RS = 1800
RS = 1600
RS = 1460
RS = 1455
RS = 1433
RS = 1345
RS = 1200
.045
Legend
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


Beardsley Wash Plan: PMF 1/28/2010 4:17:33 PM
Geom: Beardsley Wash Flow: PMF
RS = 1000
.045
.045
.045
Legend
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
1166
1165
1164
1163
1162
900
950
1000
1050
1100
Station (ft)

H.3 HEC-RAS WORK MAP

FIGURE H.1 – HEC-RAS WORK MAP 1

FIGURE H.2 – HEC-RAS WORK MAP 2

H.4 WASTEWAY NORMAL DEPTH CALCULATIONS

Worksheet for Wasteway Xsection 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.00480	ft/ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	14.00	ft
Discharge	221.00	ft³/s

Results

Normal Depth	2.48	ft
Flow Area	50.17	ft²
Wetted Perimeter	27.37	ft
Top Width	26.41	ft
Critical Depth	1.77	ft
Critical Slope	0.01649	ft/ft
Velocity	4.40	ft/s
Velocity Head	0.30	ft
Specific Energy	2.78	ft
Froude Number	0.56	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.48	ft
Critical Depth	1.77	ft
Channel Slope	0.00480	ft/ft
Critical Slope	0.01649	ft/ft

Cross Section for Wasteway Xsection 1

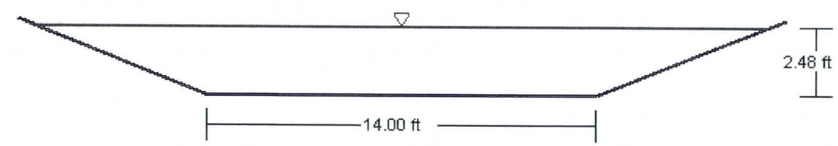
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.00480	ft/ft
Normal Depth	2.48	ft
Left Side Slope	2.50	ft/ft (H:V)
Right Side Slope	2.50	ft/ft (H:V)
Bottom Width	14.00	ft
Discharge	221.00	ft³/s

Cross Section Image



V: 1
H: 1

Worksheet for Wasteway Xsection 2

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.00480	ft/ft
Left Side Slope	10.00	ft/ft (H:V)
Right Side Slope	10.00	ft/ft (H:V)
Bottom Width	14.00	ft
Discharge	221.00	ft^3/s

Results

Normal Depth	1.95	ft
Flow Area	65.46	ft^2
Wetted Perimeter	53.25	ft
Top Width	53.05	ft
Critical Depth	1.42	ft
Critical Slope	0.01827	ft/ft
Velocity	3.38	ft/s
Velocity Head	0.18	ft
Specific Energy	2.13	ft
Froude Number	0.54	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.95	ft
Critical Depth	1.42	ft
Channel Slope	0.00480	ft/ft
Critical Slope	0.01827	ft/ft

Cross Section for Wasteway Xsection 2

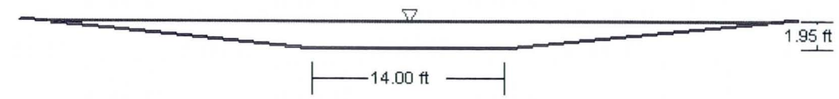
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.00480	ft/ft
Normal Depth	1.95	ft
Left Side Slope	10.00	ft/ft (H:V)
Right Side Slope	10.00	ft/ft (H:V)
Bottom Width	14.00	ft
Discharge	221.00	ft^3/s

Cross Section Image



V: 1
H: 1